ENERTEC

STABILOCK

Radiotelephony Test Set

Operating Manual

MP MASTER

MA23586

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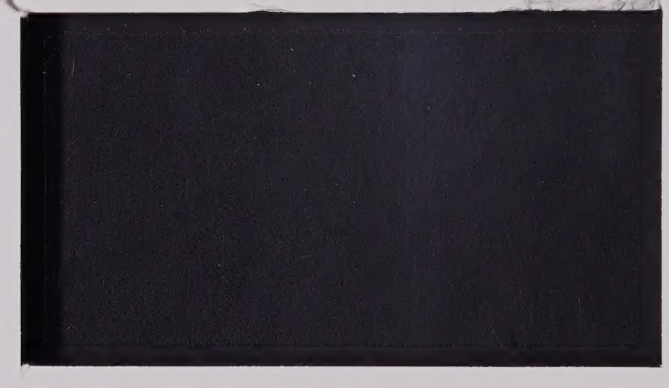

INSTALLATION DEPT.

STABILOCK

Radiotelephony Test Set

Operating Manual

SCHLUMBERGER Meßgeräte GmbH
Ingolstädter Straße 67a · 8000 München 46 · Telefon 31 70 31

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Compact Radiotelephony Test Set
STABILOCK

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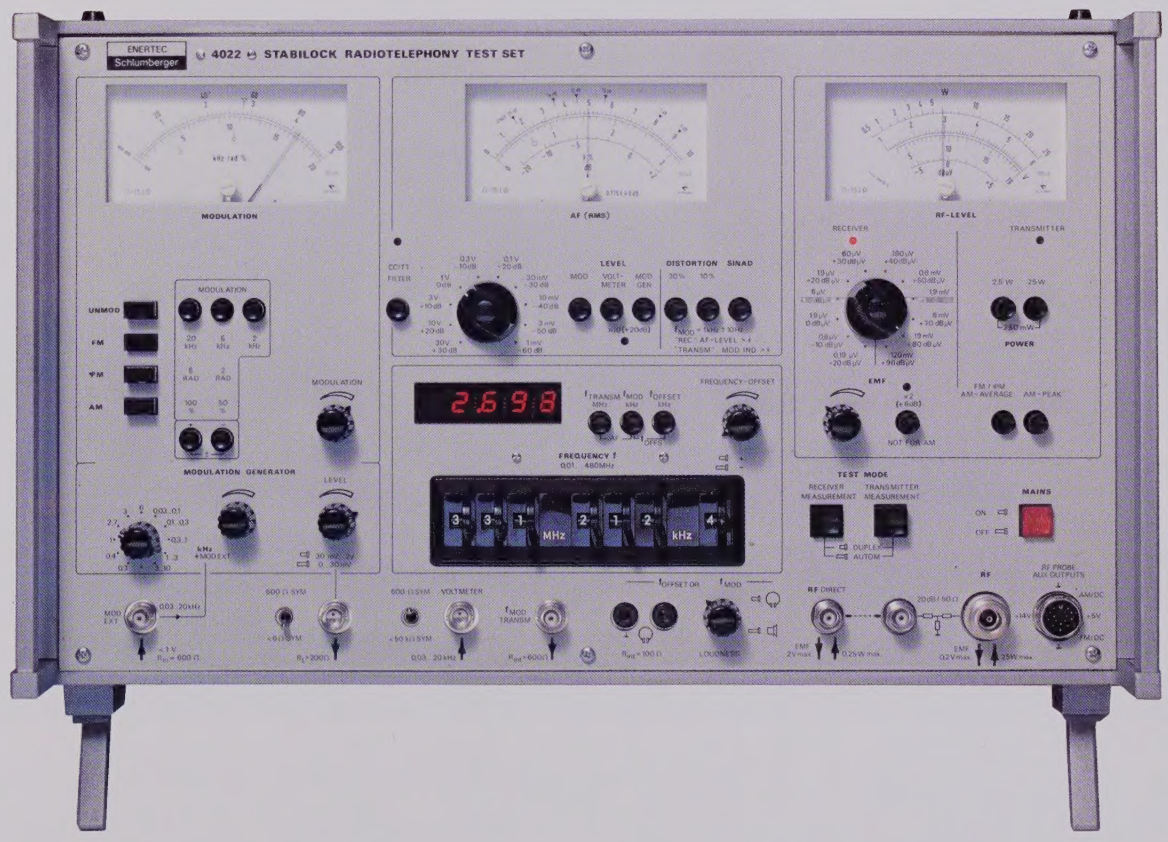

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compact test set

Contains: Programmable Frequency Synthesizer, AM, FM or φM-Modulation
AF (Modulation) Generator
RF Power Meter up to 25 W (50 W with option BP)
RF and AF Frequency Counter
AM, FM and φM Modulation Meter
AF Voltmeter
Distortion and SINAD Meter

Application

The compact STABILOCK test set provides a means of rapid execution of all measurements necessary for transmitter/receiver maintenance. Regular performance checks must be carried out on radio equipment to ensure that the specifications comply with legal requirements as well as to determine the effective transmitter range and signal quality.
The STABILOCK test set can measure:

On transmitters:
Transmitter power, carrier frequency offset, modulation values and limiting, modulation symmetry and distortion, modulation frequency response including preemphasis for phase-modulation, spurious modulation, call tone accuracy.

On receivers:
Sensitivity, tuning accuracy, band width, selection, squelch level, AF power, AF distortion, AF frequency response, AF noise level, duplex filter effectiveness.

Function

In the STABILOCK, the functions of several well known laboratory measuring devices are combined into one well-designed instrument for testing radio equipment. The STABILOCK test set needs no complicated wiring because the functions are available at the touch of a push-button. Ease of operation of the STABILOCK is ensured by a purposeful combination of these functions with a central RECEIVER MEASUREMENT/TRANSCEIVER MEASUREMENT mode switch. The TRANSMITTER MEASUREMENT mode can also be selected automatically, when the transceiver power exceeds 50 (100) mW.

Outstanding Features

The signal generator and the frequency offset and FM deviation meter of the STABILOCK test set work on the frequency synthesis principle. The use of a frequency synthesizer offers many advantages with comparison to a freerunning signal generator such as the following for example:

- Absolute setting accuracy
- Drift-free measurements
- Direct offset frequency measurements (subtraction from a 7 digit counter no longer necessary).

Further handling advantages:

- A well defined front panel layout
- A reduced number of controls and indicators in comparison to the number of available functions.
- A 6 dB button and calibrated incremental frequency control for band width measurements.
- Time saving measurements based on the SINAD method.
- Automatic levelling at distortion and SINAD measurements.

Supplementary Equipment

(Separate data sheets available)

Channel Selector
For rationalised testing of multi-channel Transceivers.

Transceiver Interface
Allows frequency setting on the STABILOCK by means of the channel selector switch of the transceiver.

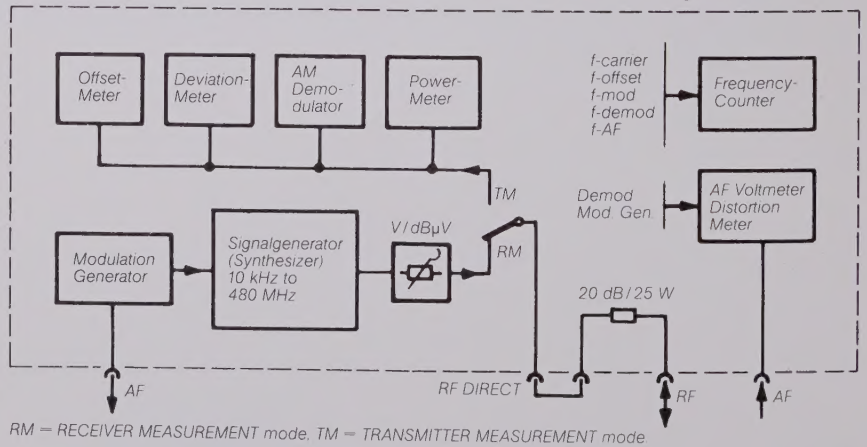
Power Adapter
For RF power measurements with the STABILOCK up to 250 W.

Selective Call Tester
Comprises 6 tone encoder and decoder

Subaudio meter
For testing transceivers with subaudio squelch corresponding to EIA-standard.

SSB Analyser
Comprises a Frequency Analyser for modulation spectrums of SSB transmitters and other SSB measurement devices.

STABILOCK 535A
SSB Test Set. Contains in a common case: STABILOCK 4022, 250 W Power Adapter, SSB Analyser, Signal Generator for 2nd signal.



RM = RECEIVER MEASUREMENT mode, TM = TRANSMITTER MEASUREMENT mode

ergonomics

Modulation Sector

Selection of AM, FM or φM modulation mode. Setting of modulation values on RECEIVER MEASUREMENT mode. Indication of measured modulation on TRANSCEIVER MEASUREMENT mode. Built-in loudspeaker.

Weighting Filter

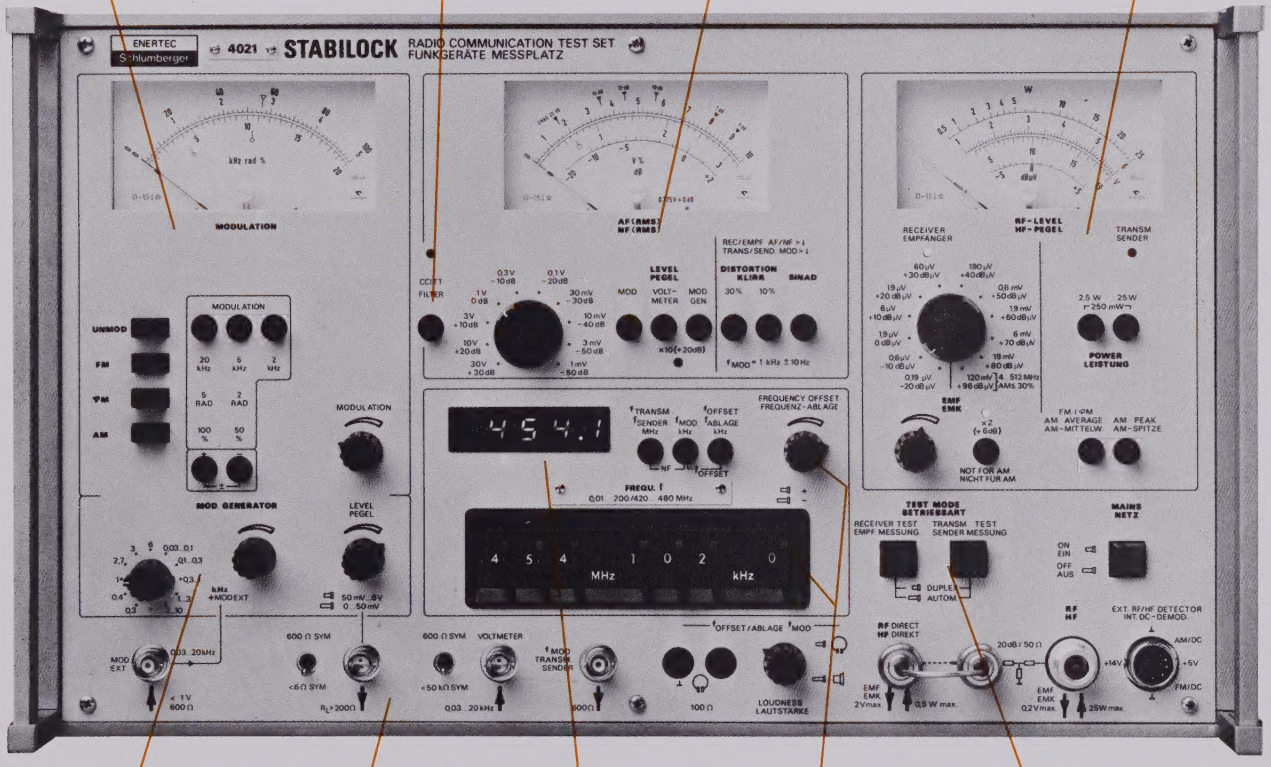
Psophometric weighting corresponding to CCITT standard. Effective to AF input or to the demod signal.

AF Millivoltmeter

True RMS meter with ranges from 1 mV to 30 V. Guarded input. Convertable into a distortion or a SINAD meter for the AF input or the demod signal. Automatic level control of the 1 kHz. fundamental wave.

RF Level

Indication of transmitter power from 5 (10) mW to 25 (50) W on TRANSMITTER MEASUREMENT mode. EMF setting from 0,05 μV to 2 V on RECEIVER MEASUREMENT mode. 6 dB push-button for band width measurements.



Modulation Generator

6 fixed frequencies and continuous range from 30 Hz to 10 kHz. Simultaneous internal and external modulation. Frequency display by the counter. Output level display by the AF voltmeter. Symmetrical output avoids hum-pickup.

Connection Section

Same cable connections to the transceiver on TRANSMITTER and on RECEIVER MEASUREMENT mode.

Frequency Counter

Display of carrier frequency with 100 kHz. resolution. Display of carrier offset frequency or of modulation frequency with 1 Hz resolution.

Frequency Setting

Manually by lever wheels or remote programmable. Incremental tuning with high resolution and selectable polarity.

Mode Selection

Central mode selection control for converting the STABILOCK into a signal generator on RECEIVER MEASUREMENT mode or into a measuring receiver on TRANSMITTER MEASUREMENT mode.
The switch-over can also be performed automatically, when the transmitter exceeds 50 (100) mW. On DUPLEX MEASUREMENT mode the STABILOCK is a signal generator and a power meter.

specifications

RECEIVER MEASUREMENT Mode

Carrier Frequency Frequency Ranges (MHz):

Type 4021:0,01 to 200 / 400 to 480
Type 4022:0,01 to 480 continuously.
Options: Frequency extension up to 512 MHz for all types. Additional range 800 to 960 MHz: refer to data sheet 4024/25.
Relative Accuracy: Same as internal crystal reference oscillator.
Frequency Setting digital in steps of 100 Hz to 100 MHz by decade switches or by remote control signal with BCD code. Positive TTL logic.
Incremental Tuning ± 0,3 to ± 10 kHz with 10 or 1 Hz display resolution.

EMF

Impedance of socket RF: 50 Ω, SWR <1.1
EMF at socket RF: 0.05 µV to 200 mV
≙ – 26 to + 106 dBµV, at socket RF DIRECT up to 2 V. (120 mV range >4 MHz only)
EMF Accuracy: Meter ± 0.4 dB, 10 dB steps ± 1.1 dB, 6 dB button ± 0.4 dB, flatness ± 0.5 dB. Additional error ± 1 dB on the 120 mV range, ± 2 dB on the 0.19 µV range. Additional error on the 480 to 512 MHz frequency range ± 1 dB.

Modulation Setting

FM: Deviation ranges 0 to 2/5/20 kHz.
Modulation frequency 300 Hz to 10 kHz internal (external up to 20 kHz).
φM: Deviation ranges 0 to 2/5 Rad
(Maximum: fmod · Rad <20 kHz)
Modulation frequency as on FM.
AM: Ranges 0 to 50/100%.
30% maximum with 120 mV EMF range.
Modulation frequency 30 Hz to 10 kHz internal and external.
Setting Accuracy: <5% ± 1.5% of fsd at fmod = 1 kHz.
Frequency response <5% from 0.3 to 10 kHz, <15% in the entire range.
Distortion: <2% at fmod 1 kHz and FM deviation <10 kHz or m <70% on AM.
External Modulation: 1 V into 600 Ω required for full modulation range values.

Spectral Purity of RF Signal

At 10 mV and 6 dB button not pressed.
Harmonics >30 dBc (dB below carrier).
Spurious signals: >70 dBc/200 to 512 MHz.
>50 dBc/0,01 to 200 MHz.
SSB noise 115 dBc/Hz typically at 20 kHz off carrier.
Spurious FM deviatian <9 Hz. Spurious φM deviation <0,01 Rad. Spurious AM >70 dB. CCITT weighted.

TRANSMITTER MEASUREMENT · Mode

Frequency Measurement

Measurement range 20 to 512 MHz.
Resolution 100 kHz.
Sensitivity >30 mV at socket RF DIRECT.

Frequency Offset Measurement

Measuring ranges 0 to ± 10 / ± 100 kHz.
Resolution 10 or 1 Hz.
Beat frequency control also by built-in loudspeaker.
Reference frequency accuracy: As for internal crystal reference oscillator.
Sensitivity >2 mV at socket RF DIRECT and from 20 to 512 MHz. Measurements possible down to 5 MHz with decreased sensitivity.

Power Measurement

Measuring range 5 mW to 25 W (10 mW to 50 W with option BP).
Selectable average or peak power display.
Accuracy on average measurement and from 4 to 200 MHz: <7% + 0.5% fsd in the 2.5 (5) and 25 (50) W ranges, <10% + 0.5% fsd in the 250 (500) mW range. Additional error <3% from 1.4 to 4 MHz and from 200 to 512 MHz.

Modulation Measurement

FM: Deviation ranges 0 to 2/5/20 kHz.
Bandwidth 30 Hz to 20 kHz.
φM: Deviation ranges 0 to 2/5 Rad Bandwidth 300 Hz to 16 kHz.
AM: Ranges 0 to 50/100%.
Bandwidth 30 Hz to 10 kHz.
Display mode: Positive or negative peak value or average of both.
Accuracy: <3% + 1.5 fsd at 1 kHz.
Frequency response ± 5% from 0.3 to 10 kHz, <15% across entire bandwidth.
Sensitivity: >2 mV on FM and φM at socket RF DIRECT from 20 to 512 MHz. Measurements possible down to 5 MHz with decreased sensitivity.
>200 mW on AM from 1.5 to 512 MHz.
Spurious modulation measurement by AF Voltmeter. True RMS weighting.
Monitoring of the demod signal by internal loudspeaker or by headphones.
Demod outputs: 1 V at fsd values of the modulation display ranges.
DC coupled AM and FM demod outputs for observation of transient responses.

AF Voltmeter

Measurement ranges: 1 mV to 30 V in a 1, 3, 10 sequence. 0 dB ≙ 0.775 V.
Automatically 20 dB less sensitive in FM/φM/RECEIVER MEASUREMENT mode (not with option BP).
Accuracy: <5% + 1.5% fsd at 1kHz.
Frequency response ± 5% from 30 Hz to 20 kHz. psophometric noise weighting selectable.
Input: Symmetrically 600 Ω or 50 kΩ.

Distortion Meter

Measures AF signal on RECEIVER MEASUREMENT and demod signal on TRANSMITTER MEASUREMENT.
Measurement frequency 1 kHz.
Ranges 0 to 10/30%.
SINAD markers at 6/7/10/12/14/20 dB.
Bandwidth as AF Voltmeter.
Accuracy: <8% + 1.5% fsd.
<1 dB at SINAD 6/ 7/ 10/ 14 dB,
<2 dB at SINAD 20 dB.
Input level reguired: >1/5 deflection of the AF voltmeter or modulation meter.
Residual distortion <0.5%.

Modulation Generator

Fixed frequencies: 0.3/0.4/1/2.7/3/6 kHz.
Accuracy <2%, <10 Hz at 1 kHz.
Continuous range: 20 Hz to 10 kHz.
Setting accuracy 1Hz.
EMF ranges: 0 to 50 mV / 0 to 6 V.
Output symmetrically 600 Ω or <6 Ω.
Summing input for simultaneous internal and external modulation.

Crystal Reference Oscillator

Accuracy 1×10^{-7} after 20 minutes at 20°C ambient temperature.
Ageing $<1 \times 10^{-8}$/day after 8 weeks, $<1 \times 10^{-6}$/year.
Temperature drift $<1 \times 10^{-9}$/°C.
Output: 10 MHz/EMF 0.4 V/Ro 50 Ω.
Input signal required for external synchronization: 10 MHz / >3 V into 150 Ω.
Pulling range appr. 1×10^{-6}.

General Data

Mains: 110/120/130/220/230/240/ V.
–15 to + 10%, 47 to 66 Hz, 50 Watts.
Battery operation: 11 to 15 V, 4.5 A.
Operating temperature +5 to +40°C.
Storage temperatur –25 to +65°C.
Width 443 mm, hight 264 mm, depth 374 mm
Wight appr. 17 kg.

Recommended Accessories

Front panel cover with cable set Order number 248000
Shoulder Bag for STABILOCK of imitation leather. Order number 860001
BNO/BNC Adapter
Order number 383062

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SCHLUMBERGER MESSGERÄTE GMBH / HF-TECHNIK
INGOLSTÄDTER STR. 67 A
D-8000 MÜNCHEN 46
TEL. (089) 31 70 31 · TELEX 05 215 015 smg d

30 month guarantee for the standard version only.

Enertec is bound by the foregoing specifications only after confirmation.

3 INSTALLATION INSTRUCTION

3.1 General

This instrument was given a thorough mechanical and electrical check prior to being packaged for shipment. Should you, however, ascertain any kind of fault or deficiency in the instrument, please get in touch with our sales office. These people are best equipped to remedy any faults in the shortest possible time.

Note that permissible ambient temperature is between 5°C and 40°C for operation (–25°C and +65°C shelf).

Power cable has safe neutral meeting German VDE requirements. Should the power plug be changed against another type please make sure, that the yellow/green conductor is connected to the plug safety contact.

3.2 Power Supply

The STABILOCK can be operated on the following mains voltages:
110/120/130/220/230/240 V (–15. . . + 10%)
The instrument is works adjusted for 220 VAC operation. To change for another voltage, turn the mains selector switch on the rear panel to the required position.

Fuse specified for

110/120/130 VAC . . . T 1,25/250 B	(1,25 Amps)
220/230/240 VAC . . . T 0,63/250 B	(0,63 Amps)

3.3 Remote Battery Operation

A battery, i. e.

11 . . . 15 V approx.4,5 Amps

is necessary for cordless operation. For connecting the battery, a two pin plug is located on the instrument rear panel. Following parts are required for connecting the battery to the STABILOCK:

a) Coupler socket "stack 2"
Hirschmann order no. 930 621 - 100
Schlumberger HNK no. 884 005

b) Clamp "stasi 1"
Hirschmann order no. 930 638 - 100
Schlumberger HNK no 884 006

Fuse specified for external battery (located near to connecting plug).
F 6,3/250 E (6,3 Amps)

Charging the battery by the STABILOCK is not possible. Mains ought to be switched off, when operating on external battery.

3.4 Switching-on

The instrument is switched on by actuating the MAINS button (27) or by connecting to the external battery source. This instrument is not provided with a STAND-BY mode. In but 20 minutes the integral crystal standard attains its accuracy of $1 \cdot 10^{-7}$ for an ambient temperature in excess of 20°C.

3.5 External Sync

Should in special instances the accuracy of the integral crystal oscillator not be sufficient, an external reference can be connected through the rear panel socket, this requiring:

f = 10 MHz
V>0,3V into 150 Ω

Pulling range is approx. $1 \cdot 10^{-6}$

3.6 Crystal Frequency Correction

Should the frequency drift of the STABILOCK become intolerable due to ageing of the internal crystal reference a correction can be made using the rear panel adjustment control.

3.7 Remote Frequency Control

A 50-pole rear panel connector is provided for BCD control (TTL compatible) for remote adjustment of instrument frequency. Control signals must satisfy the following requirements:

100 Hz to 1 MHz decade (contacts 9 to 28),
LOW = –0,5 . . . +0,8 V, for any source impedance or no control potential
HIGH = +2,0 . . . +5,5 V, source impedance $< 1k\Omega$

10 MHz and 100 MHz decade (contacts 1 to 8):
LOW = –0,5 . . . +0,8 V, source impedance $< 100\ \Omega$
HIGH = +2,0 . . . +5,5 V, for any source impedance or no control potential

Contact Function

Contact	Function		Contact	Function	
1	100		17	10	
2	200	–MHZ steps	18	20	–kHz steps
3	400		19	40	
4	800		20	80	
5	10		21	1	
6	20		22	2	
7	40	–MHz steps	23	4	–kHz steps
8	80		24	8	
9	1		25	100	
10	2		26	200	
11	4	–MHz steps	27	400	–Hz steps
12	8		28	800	
13	100				
14	200		47	Remote Control ON/OFF	
15	400	–kHz steps			
16	800		49	+ 5V; Ro = 100 Ω	
			50	Ground	

Socket suitable for Amphenol 50-pole plug, BN 884 206

3.7.1 Remote Control with Type 4932 Channel Selector

Rear panel remote control socket will also provide direct connection for type 4932 CHANNEL SELECTOR permitting fast channel stepping up to 20 preset frequencies. Only the lower band frequency is required. A toggle switch on the Channel Selector permits automatic adjustment of the corresponding upper band frequency with the aid of an offset calculator. Offset frequency is adjusted on the Channel Selector. To select mode REMOTE CONTROL front panel frequency decade switch (40) must be set to 900.0000 MHz or to 600.0000 MHz starting with serial number 142831 respectively.

3.7.2 Remote Control with Switches

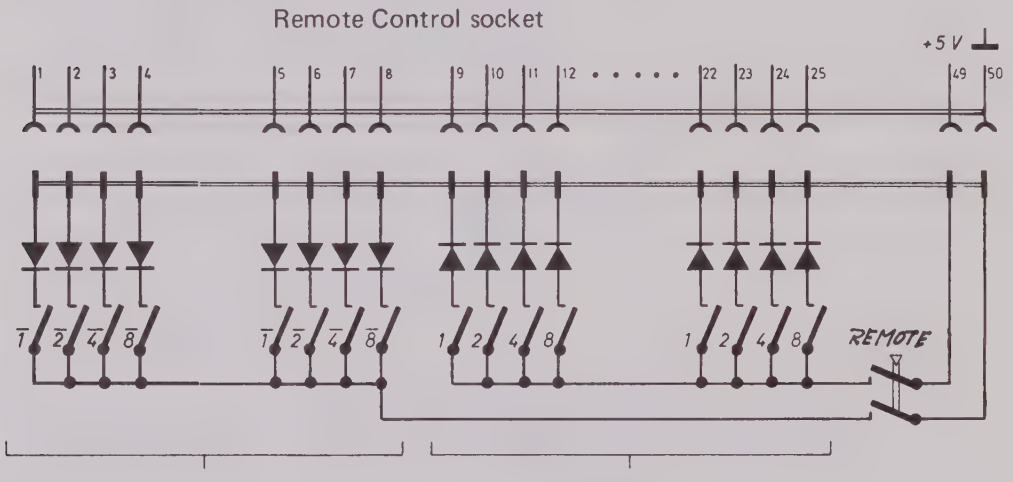
For manual remote control of the 100 Hz to 1 MHz decades HIGH requires + 5 V on contact 49 and LOW for the 10 MHz and 100 MHz decade requires grounding contact 50. Should code switches be used, complement types are required for the 10 MHz and 100 MHz decade.

In REMOTE CONTROL mode decade frequency control switch (40) must be set to

900.0000 MHz or
600.0000 MHz starting with serial no. 142831 resp.

When returning to manual setting disconnect remote control plug.

Having to disconnect the remote control plug can be avoided by using the following switching arrangement necessitating additional buffer diodes and a 2-pole switch.



BCD complementary switches BCD switches

3.7.3 Frequency Presetting using Remote Control

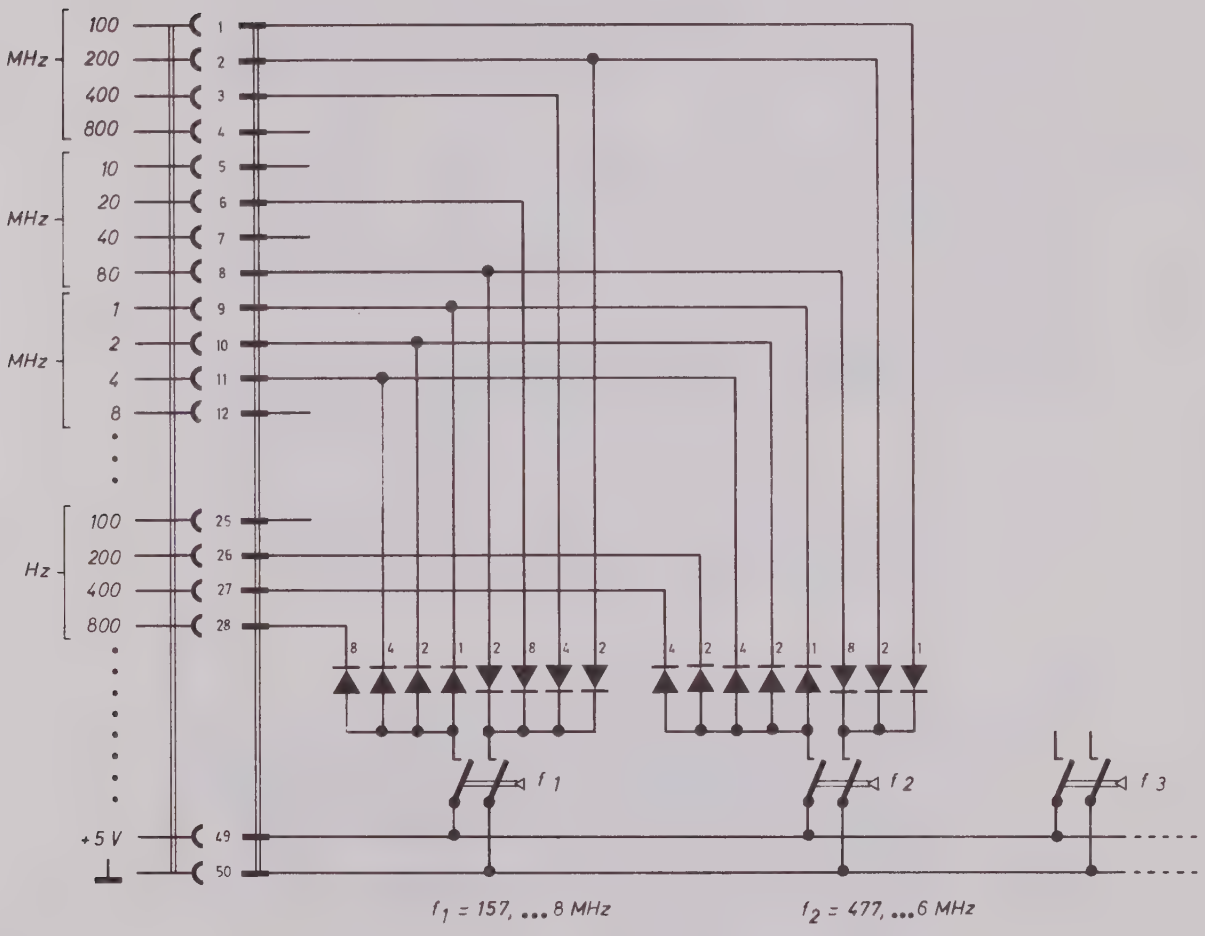
The following switching arrangement comprising diodes and a 2-pole rotary or pushbutton switch permits frequency preselection for rapid location.

This arrangement requires the diodes to be configured according to the desired frequencies:

Each on-line conductor in the 100Hz to 1MHz decades (contact 9 to 28) requires a diode in the direction of the plug, i.e. for the value 7 one diode each for conductors weighted 1,2 and 4.

Complementary 10MHz and 100MHz decades require, however, diodes in the reverse direction for conductors not on-line, i.e. for the value 7 only one diode for the conductor weighted 8. Conductor 8 does not need to be switched in the 100 MHz decade (this is contact 4).

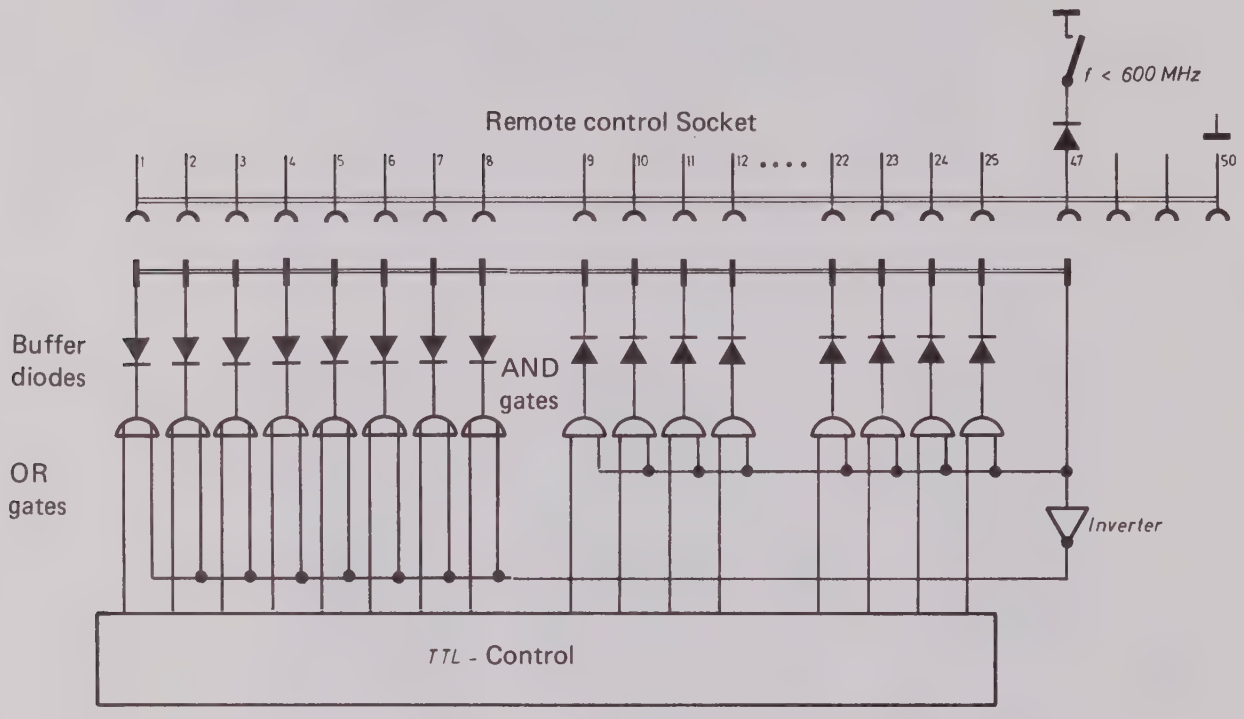
Example:



The STABILOCK frequency switch must be set to 900.0000 (600.0000) MHz. For internal frequency adjustment of the STABILOCK using (40) all 2-pole switches must be open, e.g. by using a further actuating push-button.

3.7.4 TTL compatible Remote Control

If the remote control unit has TTL output and it is required to avoid having to disconnect the remote control plug when changing to manual control (40) use the following adapter circuit:



Frequency adjustment for remote control: 900.0000 MHz or 600.0000 MHz starting with serial number 142831 respectively.

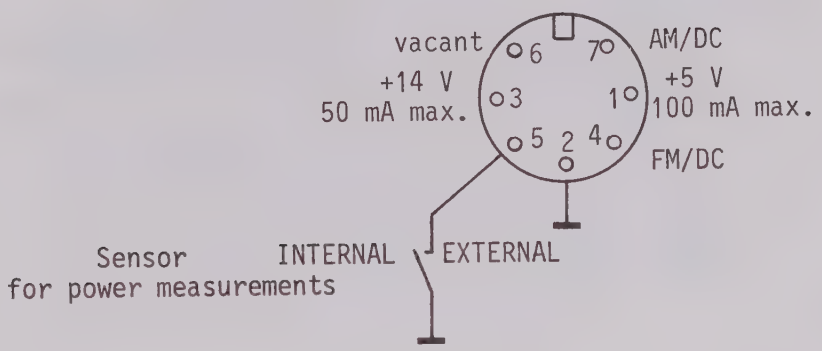
3.7.5 2 MHz Frequency Increase

On some instruments provision has been made on customer request for increasing all frequencies set on decade switch (40) by 2 MHz.
This necessitates shorting contacts 40 and 50 of the remote control plug.
This frequency increase facility is only possible on RECEIVER MEASUREMENT mode of operation.

3.8 Socket RF PROBE / AUXILIARY OUTPUTS

PIN functions (front face of socket)

Mating plug: 884 271



AM/DC

DC coupled AM demodulation output for connecting an oscilloscope. Provides observation of transmitter power transient responses.

Frequency range		0 to 10 kHz
Source impedance		appr. 400 Ω
EMF	=	+ 3 V at 0 Watts
		+ 11 V at 25 Watts

FM/DC

DC coupled FM demodulation output for connecting an oscilloscope. Provides observation of transient responses of the transmitter frequency, when changing to other channels.

Frequency range	0 to 20 kHz
Source impedance	appr. 20 kΩ
EMF	appr. 160 mV peak at 20 kHz deviation

+5 V/ +14 V

Contacts for supplying external circuit arrangements with low current consumption, e.g. pre-amplifiers.
Caution: If more current is drawn as 50 mA from the +14 V contact or 100 mA from the +5 V contact, the function of the STABILOCK will be disturbed.

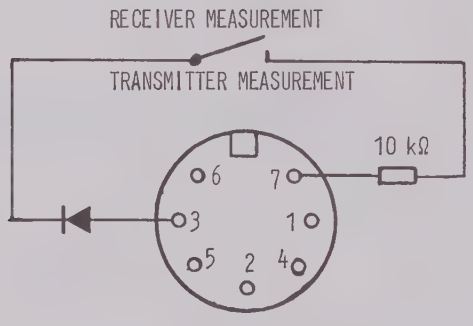
Contact no. 2

Ground potential of the STABILOCK

RF PROBE

To the socket RF PROBE external power measurement heads for additional measurement ranges can be connected.
The external probe links contact no. 5 to ground and by this the STABILOCK power meter is switched to the external probe. Voltages of +3 to +11 V applied to contact no. 7 by the external probe correspond to zero and full scale deflection of the meter. The full range value, e.g. 250 Watts depends on the RF probe and a corresponding correction factor (e.g. 10) must be applied to the power reading.

Remote selection of the RECEIVER/TRANSMITTER MEASUREMENT modes



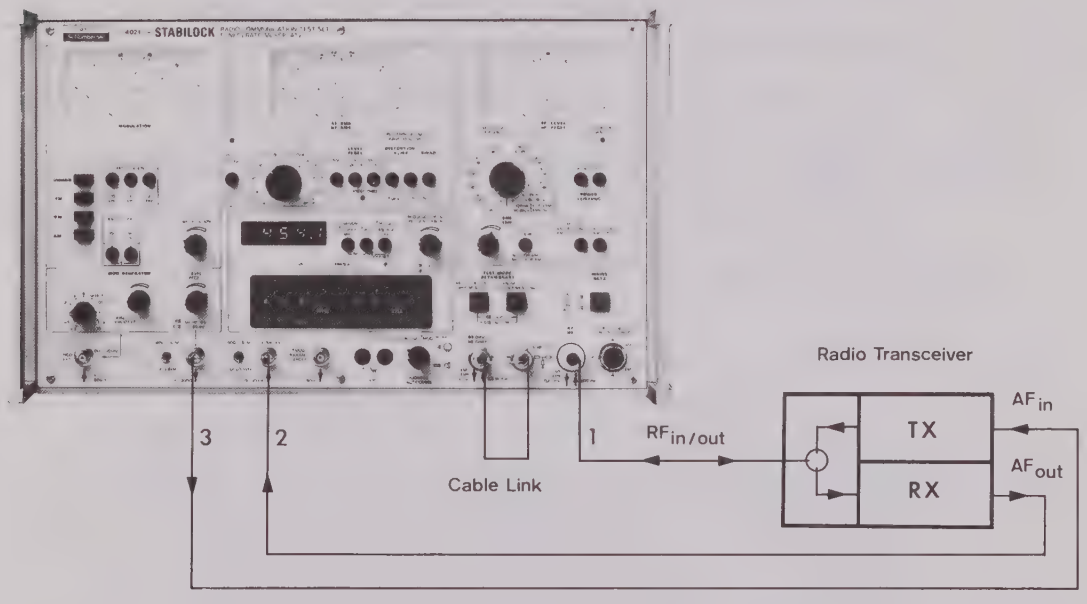
By means of this arrangement the STABILOCK can be switched from RECEIVER MEASUREMENT to TRANSMITTER MEASUREMENT mode by closing external contacts.
On power measurements a residual meter reading of appr. 50 mW will occur.

4 OPERATING INSTRUCTIONS

4.1 Operating Controls

Front panel controls are described at the end of this manual. The numbering of the controls used in this text holds for all pages in this manual.

4.2 Connecting Test Transceiver



3 cable connections between the transceiver under test and the STABILOCK instrument are usually sufficient to carry out all measurements required.

1. Cable with N plug for RF connection
   (STABILOCK RF connection (28) cannot be changed)
2. Cable with BNO plug for connecting the AF voltmeter to the transceiver AF output (headset output).
3. Cable with BNO plug for connecting transceiver AF input to STABILOCK modulation generator.

A cable link on the STABILOCK connects the unprotected RF DIRECT output/input (31) with the RF output/input (28) protected by a power attenuator.
On remote measurements this link is removed and the antenna connected to the RF DIRECT socket (31).

Caution! Avoid overloading the RF DIRECT connection. Any power input in excess of $> 0{,}25$ W $\hat{=}$ 3,5 V into 50 Ω will result in damage of sensitive circuit components.

4.3 Frequency Adjustment on Receiver Measurements

(RECEIVER MEASUREMENT pushbutton (32) actuated)

4.3.1 Frequency adjustment without vernier offset

In the RECEIVER MEASUREMENT mode frequency adjustment is possible, as required, with or without vernier offset.
If the f OFFSET button (35) is not actuated, the frequency selected on the decade frequency switch FREQUENCY f (40) – i.e. channel frequency – will appear at the STABILOCK RF output. This frequency can be adjusted also by remote control (see 3.7.).

4.3.2 Frequency Adjustment with Vernier Offset

Infinitely variable frequency adjustment is of advantage on receiver bandwidth measurements, this requiring the f OFFSET (35) pushbutton on the STABILOCK to be actuated. The FREQUENCY OFFSET knob control (33) then permits continuous frequency offset (300Hz . . . 10kHz) with respect to the channel frequency selected on the decade switch or by means of remote control. This offset frequency is displayed by the counter with 10 Hz resolution, as long as the pushbutton (35) is depressed.

The resolution will be 1 Hz, if pushbuttons f OFFSET (35) and f MOD (37) are depressed simultaneously.

Pressing the f OFFSET button (35) causes the sign of the counter display to blink.

The blinking shall draw the operator's attention to an unwanted frequency offset adjustment.

A push-pull switch coupled to the FREQUENCY OFFSET control (33) permits selection between positive and negative offset, thus facilitating detection of any lack of symmetry in the receiver pass band with respect to the channel frequency.

If push button f OFFSET (35) is actuated, and no offset frequency is shown by the counter display, push or pull switch for selecting offset polarity (33) for one time.

4.3.3 Frequency Ranges

STABILOCK frequency ranges correspond to those of the most important transceiver bands in the frequency range up to 480 MHz.

IF range	10 kHz	...	39.9999 MHz
4m band	60	...	99.9999 MHz
2m band	140	...	179.9999 MHz
70cm band	420	...	479.9999 MHz

Frequencies wrongly selected, i.e. outside of the stated frequency ranges will cause the counter display to blink irrespective of the frequency measuring mode adjusted on the counter.
The maximum adjustable decade frequency at the upper ends of the ranges is always 100 Hz less than the full 1 MHz step. Vernier offset will permit attaining the full 1 MHz step limit, if required.

4.3.4 Counter Check of Frequency

In the RECEIVER MEASUREMENT mode the counter will display the frequency adjusted on the STABILOCK when the f TRANSMITTER pushbutton (38) is actuated. Resolution is 100 kHz.

This display can be used as a transient frequency check for repeated changes of frequency or as a remote control frequency check.

4.4 Modulation Adjustment on Receiver Measurements

On RECEIVER MEASUREMENT the STABILOCK operates as an RF signal generator with FM, φM and AM modulation by pushbutton selection (52) (51) (50).

Modulation is provided by the internal modulation generator (see 4.11) or by an external signal applied to socket EXT MOD (43). Also simultaneous internal and external modulation is possible.

The knob MODULATION (6) for adjustment of internal modulation does not act on the external modulation signal. For external modulation 1 V rms is required at the MOD EXT (43) socket for full range of the actual modulation range. The modulation meter (1) and the range selection buttons (2) (3) (4) are effective on both the internal and external modulation.

Polarity of indicated deviation can be selected by actuating the + (49) or – (48) pushbutton. Average deviation with respect + and – value is indicated if both or none of the pushbuttons are depressed.

Actuating the f MOD pushbutton (37) causes the frequency counter to display the internal or external modulation frequency when the meter (1) indication is in excess of 20% f. s. d. (mark ȯ). The frequency applied to the AF input (41) is measured, when pushbutton f TRANSM (38) is actuated additionally to the f MOD pushbutton.

Amplitude modulation to full depth of modulation is only possible with pushbutton X2/+6dB (23) not depressed. Should the EMF be increased by 6 dB by actuating this button, modulation distortion is considerable even on depths of modulation as low as approx. 10%.

4.5 EMF Adjustment on Receiver Measurements

In the RECEIVER MEASUREMENT mode the RF level meter (18) indicates the EMF available for the receiver of the unit under test, this causing the RECEIVER pilot light (16) to light up.

EMF adjustment requires operation of the RF voltage divider (17) adjustable in 10 dB increments and control (26) for approx. 12 dB continuous adjustment.
When the X2/–6 dB pushbutton (23) is actuated the EMF is 6 dB higher than the value resulting from the position of the divider and the meter indication. The latter then corresponds to the terminal voltage into a load of 50Ω. The + 6 dB pushbutton is generally used to facilitate reading receiver input voltage instead of the STABILOCK EMF. The indicated EMF is valid for the protected RF output (28).

Removing the link presents a 20 dB higher EMF of max. 2 V at the RF DIRECT output (31). This output must, however, be confined to a transmitter output of max. 0.25 W to avoid damaging the RF divider or the output circuit.
At this output the EMF accuracy tolerance is ± 1 dB higher than the values stated in the specification for the 'guarded' output (28).

In the "120 mV / +96 dBµV" position of the RF attenuator (17) the dBµV scale on the RF level meter is usable only. There is no voltage scale provided. The inscription "120 mV" is valid at full scale deflection of the RF level meter only.

2 V EMF for instance, is available by means of following control positions:

RF attenuator position	+ 96 dBµ
RF meter reading	+ 4 dBµV
output RF DIRECT	+ 20 dB
6 dB button pressed	+ 6 dB
	EMF = +126 dBµV resp. 2 V

Conversion dBµV into dBm : dBm = dBµV -113

4.6 Measurement of Transmitter frequency

(Pushbutton TRANSMITTER MEASUREMENT (29) actuated)

4.6.1 Coarse Frequency Measurement using Counter

In the TRANSMITTER MEASUREMENT mode counter (42) displays the transmit frequency with a resolution of 100 kHz in the 20 . . . 500 MHz range (continuous) as long as the f TRANSM pushbutton (38) is actuated and the RF socket (28), or if the external link is removed, the RF DIRECT socket (31) has a usable transmit signal.

This requires an input voltage of 30 mV . . . 3,5 V ≙ 18 µW . . . 250 mW at the RF DIRECT Socket which could also be denoted the telemeter socket.
Approx. 300 mV is required at the protected RF socket (28), i.e. with the external link between (30) and (31).
With insufficient transmit signal strength the counter display will blink.

4.6.2 Measuring Transmit Frequency Offset

With pushbutton f OFFSET (35) depressed counter (42) displays frequency offset, i.e. the difference frequency between the received, unmodulated transmit frequency and the channel frequency adjusted with the FREQUENCY f switch or by remote control with resolution 10 Hz.
The resolution becomes 1 Hz, if pushbutton f MOD (37) is depressed additionally to f OFFSET (35).
The counter also reads frequency offset polarity (+,–).

In this mode the sensitivity of the instrument is very much higher than when directly measuring the transmit frequency using the counter. The RF DIRECT socket (telemeter input) (31) requires approx. > 2 mV, the protected RF socket (28) requiring > 20 mV.

If a frequency is adjusted outside of the stated frequency ranges (see 4.3.3) when establishing transmit frequency offset on the decade switch (40) or should the offset exceed 99.99 kHz both will cause the counter display to blink. Wrong counter display is possible in the transition zone between insufficient und adequate signal level.

The offset frequency (beat) can be made audible via the internal speaker or using a headset. A combined control and push/pull switch (34) serves to adjust volume and switch the speaker to the headphones.

4.6.3 Frequency modulated Carrier Signal

The circuit design of the STABILOCK also permits establishing the average frequency of a frequency-modulated signal.
To achieve blinkless display of the frequency offset (see 4.6.2) on the counter a frequency offset is necessary which is somewhat larger than the frequency swing of the test signal.
The required offset is selected using the decade switch (40) once established by means of the frequency swing measurement (see 4.7.1).
To check: Sufficient frequency offset is indicated by the polarity remaining either + or — .

The average carrier frequency is obtained by adding or subtracting the ± offset frequency accordingly to the frequency selected on the decade switch.

4.7 Modulation Measurement on Transmitter Measurements

4.7.1 Measuring Ranges

The modulation measuring ranges can be selected by actuating the buttons (2), (3) or (4) in connection with the type of modulation buttons (50) to (53).

Peak rectification is used in the useful modulation ranges for modulation metering.
The polarity of the modulation value (positive or negative peak swing on FM and φM or positive and negative peak modulation on AM) is selected with the aid of pushbuttons (48) and (49). If the + and - buttons are pressed or released simultaneously, the average value of the positive and negative peak is indicated.

4.7.2 Spurious Modulation Measurement

Any transmitter modulation can be indicated additionally on the AF voltmeter by pressing the MOD button (5). The AF meter reading enables:

- True rms measurement of spurious modulation.
- Reading of useful and spurious modulation as dB values and thus simplified evaluation of the signal to noise ratio.

Conversion of voltmeter reading into modulation value:

- Voltmeter reading 1 V $\hat{=}$ full range value of the actual modulation measurement range.

From this for instance, the modulation sensitivity of the voltmeter is 2 Hz/mV if the 2 kHz FM measurement range is selected. A reading of 32 mV would give a spurious deviation of 2 mV/Hz x 32 mV = 64 Hz.
On spurious measurements due consideration must be given to the inevitable parasitic deviation and AM of the synthesizer (see data under "Spectral purity"). It is good practice to make use of the CCITT weighting filter whenever testing transceivers.

4.7.3 Input Level and max. Frequency Offset on FM and φM Measurements

Required input levels for FM and φM measurements:

> 2 mV at RF DIRECT socket (31)
> 20 mV at RF socket (28)

If the input level is insufficient the display is falsified and the demodulated signal presents a wrong signal to noise ratio,
The frequency offset of the carrier signal to be tested must be checked prior to each FM and φM measurement (see 4.6.2). If frequency offset is excessive ($>$ 10 kHz) the indication of frequency deviation will be falsified and demodulation distortions result.
The frequency offset must thus be reduced to a small value with the decade switch (40) prior to Fm and φM measurements.

4.7.4 Input level on AM Measurements

AM measurements require an input level of:

200 mW average carrier power up to 25 W peak power at the RF socket (28).

Max. permissible average carrier power depends on the depth of modulation (6,25 W for m = 100%). Check peak power prior to AM measurements by depressing the AM PEAK pushbutton (24).

AM measurements via socket RF DIRECT (31) are not possible. When carrying out measurements of depth of modulation with the instrument, setting the level of the carrier is provided automatically over the complete range of power indication. If power indication is provided it is sufficient to merely select the pushbuttons for AM (50) and the modulation range (2) (3) (4) (5).

4.7.5 Counter Display of Modulation Frequency

The counter (42) will display the frequency of the demodulated signal when the f MOD pushbutton (37) is actuated.
REQUIREMENT: Modulation meter reading must be > 1/5 of f. s. d (ó mark).

In noise modulation ranges the counter display may be disturbed by superimposed noise voltages and it will blink when the modulation frequency exceeds 9.999 kHz.

4.7.6 Determining Modulation Distortion

Meter (9) will indicate distortion of the demodulated signal in the TRANSMITTER MEASUREMENT mode subsequent to actuating one of the distortion range pushbuttons 30% (13) or 10% (14).
REQUIREMENT: modulation frequency must be 1 kHz ± 10 Hz and meter reading > 1/5 f. s. d (ó mark).

Set Level is not necessary.

In case of a weak transmitter signal and small FM deviation distortion measurement is more or less falsified by superimposed noise voltage. The CCITT weighting filter (pushbutton WEIGHTING (7)) is also effective for indicating distortion.

4.7.7 Acoustical Check of Modulation

Operating pushbutton f MOD (37) will permit an acoustical check of the demodulated signal in useful and noise ranges by means of the internal speaker or the headphones. Volume and changeover from speaker to phones are permitted by the combined control and push/pull switch (34). Howl may result in sensitive noise modulation ranges if speaker volume is turned up too loud.

4.7.8 Output f MOD TRANSMITTER

This output (39) serves to monitor the demodulated output by means of and oscilloscope.
Voltage output is 1 V assuming a sinusoidal test signal and modulation meter f. s. d. Depressing the WEIGHTING pushbutton (7) causes the CCITT weighting filter to be in circuit with the f MOD TRANSMITTER output in all noise and useful modulation ranges.

4.8 Telemetering

Frequency measurements and modulation measurements (see 4.6 and 4.7) can be carried out using an antenna connected to the RF DIRECT socket (31). This is most readily achieved using a $\lambda/4$ telescopic rod antenna. This arrangement will result in the following radiator lengths for individual frequency ranges:

range 60 . . . 100 MHz (4m band) . . . 1 m
range 140 . . . 180 MHz (2m band) . . . 50 cm
range 420 . . . 480 MHz (70cm band) . . . 17 cm

A high-power transmitter in the direct vicinity will detriment the input sensitivity.

4.9 Power Measurement

In the TRANSMITTER MEASUREMENT mode the pilot light TRANSMITTER (20) comes on and the RF meter (18) indicates the power output of the transceiver at socket RF (28). Pushbuttons (19) (21) are provided for selection of the meter ranges 50 mW to 2.5 W or 0.5 to 25 W. For selection of the 5 to 250 mW range press both buttons simultaneously.

Power measurement via the RF DIRECT socket (31) is not possible.

> Accidental overloading of the RF DIRECT socket (31) will result in damage of the instrument's calibration circuit or output circuit.

Precise power measurements require the link be intact between the RF DIRECT socket (31) and the power attenuator pad (30).

on AM test signals actuating the AM PEAK pushbutton (24) will provide indication of transient peak modulation power.

Caution: Electrical zero of the power meter depends on the selected power range and is not identical with mechanical zero.
Do not adjust mechanical zero when the instrument is switched on.

The FM/φM/AM AVERAGE pushbutton (25) is to be used for power measurements of FM and φM modulated signals, average carrier power (equivalent to unmodulated carrier) being indicated for AM modulated signals.
Should the pushbutton positions be different for an FM or φM modulated signal it can be taken that AM is simultaneously present.

4.10 Duplex Operation

This is the STABILOCK mode for testing transceiver frequency duplex circuits.

This mode is selected by operating both the RECEIVER MEASUREMENT (32) and TRANSMITTER MEASUREMENT (29) pushbuttons simultaneously which will then remain ON.

In this mode the instrument provides the receiver of the test unit with the output established previously during the RECEIVER MEASUREMENT via RF socket (28) and simultaneously measures the power output from the transmitter of the transceiver under test at the RF socket.

4.11 Modulation Generator

Frequency adjustment is achieved using the range switch (47) and a ten-turn potentiometer control (45) for the range of infinitely variable adjustment, the latter permitting high frequency resolution (1 Hz).

The frequency of the modulation generator is displayed by the counter (42) as long as modulation was adjusted previously in the RECEIVER MEASUREMENT mode. The instrument thus provides the following adjustment capabilities:

1. Operate pushbutton (32) RECEIVER MEASUREMENT
2. Actuate one of the pushbuttons FM (25), φM (51) or AM (50).
3. Adjust for > 1/5 f. s. d (δ mark) on the modulation meter (1) using the MODULATION control (6).
4. Depress pushbutton f MOD (37).

Frequency indication with pushbutton UNMOD (53) actuated is not possible.

In the TRANSMITTER MEASUREMENT mode the frequency of the modulation generator is displayed by the counter (42) when the push buttons

MOD. GEN. (12)
f_{MOD} (37)
f_{TRANSM} (38)

are pressed and the AF voltmeter reading is > 1/5 fsd.

Due to a special circuit arrangement the instrument's frequency counter requires only 250 ms (instead of 1 sec) count time for 1 Hz frequency resolution thus greatly facilitating precise frequency adjustment.

The modulation frequency in the 1 kHz position of the range switch (47) has an accuracy of ± 10 Hz as required for distortion measurements.

The EMF of the modulation generator can be varied over 2 ranges from < 1 mV to 6 V using the combined control/ push-pull switch (44). The source impedance can be switched to 600 Ω or to < 6 Ω. At the output socket (43) of the modulation generator the terminal voltage is measured and can be read from the AF voltmeter (9) when the MOD GEN push button (12) is actuated.

4.12 AF Millivoltmeter

Button actuated:	The AF millivoltmeter measures:
VOLTMETER (11)	level at socket VOLTMETER (41)
MOD GEN (12)	terminal voltage of the modulation generator (43)
MOD (5)	demodulated transmitter modulation

The AF millivoltmeter input, socket AF (41) is practically insensitive to hum pickup, which occurs sometimes, when a number of test instruments are interconnected (for guard circuit see 5.1.3).

Actuating the WEIGHTING pushbutton (7) causes millivoltmeter frequency response (normally 30 Hz . . . 20 kHz) to assume that of a psophometric filter to CCITT specifications. Same sensitivity of the filter only for f = 800 Hz (see 4.15).

Operating one of the FM (52) or φM (51) pushbuttons causes the x10/+20 dB light (10) to illuminate on RECEIVER MEASUREMENT and millivoltmeter sensitivity to be reduced by 20 dB. In this instance the indicated voltage requires multiplying by 10 or 20 dB added to the indicated voltage.

This arrangement facilitates establishing the 20 dB s/n ratio in determining transceiver receiver sensitivity (see R-2).

Note: Max. AC input = 50 V
Max. DC input = ± 50 V

4.13 Distortion Meter

The AF millivoltmeter indicates distortion when either 30% (13) or 10% (14) or the SINAD pushbutton (15) is actuated.
The distortion meter is automatically switched to the test signal at:

AF input (41) on RECEIVER MEASUREMENT
output f MOD TRANSM (39) on TRANSMITTER MEASUREMENT

The following requirements must be satisfied for indication of distortion on RECEIVER MEASUREMENT:

AF millivoltmeter reading > 1/5 (ó mark) of f. s. d
and voltage > 10 mV.
Test frequency f = 1 kHz ± 10 Hz

to be checked prior to measuring distortion by actuating AF pushbutton (11) and selecting the suitable range (8).
To determine transceiver modulation distortion in the receiver the STABILOCK is switched to internal modulation and the demodulated receiver output provided at the NF input (41). Accuracy of the modulator generator frequency in the 1 kHz position of the range switch (47) is ± 10 Hz as required for distortion measurements.

The following requirements must be satisfied for indication of distortion on TRANSMITTER MEASUREMENT:

modulation meter (1) reading > 1/5 (ó mark) of f. s. d
See also 4.7.6

To check modulation generator distortion, link output (43) to AF input (41).

Distortion meter has a SET LEVEL facility thus eliminating level adjustment prior to distortion measurement otherwise necessary.

The SINAD pushbutton (15) is provided for establishing receiver sensitivity according to IEC and CEPT recommendations using the SINAD method.
This method is easier than conventionell sensitivity measurement by establishing the 20 dB s/n ratio. In the SINAD method a signal having standard modulation is presented to the input of the receiver and the input voltage reduced to the extent that the demodulated output of the receiver contains a certain proportion of unwanted components. The term SINAD results from

$$\text{SINAD} = \frac{\text{SIGNAL, NOISE and DISTORTION}}{\text{NOISE and DISTORTION}}$$

Input voltages for SINAD ratios of 6, 7, 10, 12, 14 and 20 dB are currently being established, the scale (9) of the AF millivoltmeter being marked accordingly.
It is necessary that a check be made for AF level $>$ 1/5 of f. s. d by actuating the AF pushbutton (11) when carrying out SINAD measurements with the instruments as for distortion measurements in the RECEIVER MEASUREMENT mode. The SINAD pusbutton is then actuated and the EMF (26) (17) reduced to the extent that the needle of the millivoltmeter points to the required mark . The voltage then adjusted and available at the receiver input (= EMF/2) corresponds to receiver sensitivity. It is good practice to make use of the psophometric filter for this measurement by operating the WEIGHTING pushbutton (7).

4.14 Frequency Counter

The function of the counter is described in the following:

- 4.3.2 Frequency adjustment with fine offset
- 4.3.3 Frequency ranges
- 4.3.4 Counter check of frequency
- 4.4 Modulation adjustment
- 4.6.1 Coarse frequency measurement using the counter
- 4.6.2 Measuring transmit frequency offset
- 4.6.3 Frequency-modulated carrier signal
- 4.7.5 Counter display of modulation frequency
- 4.11 Modulation generator

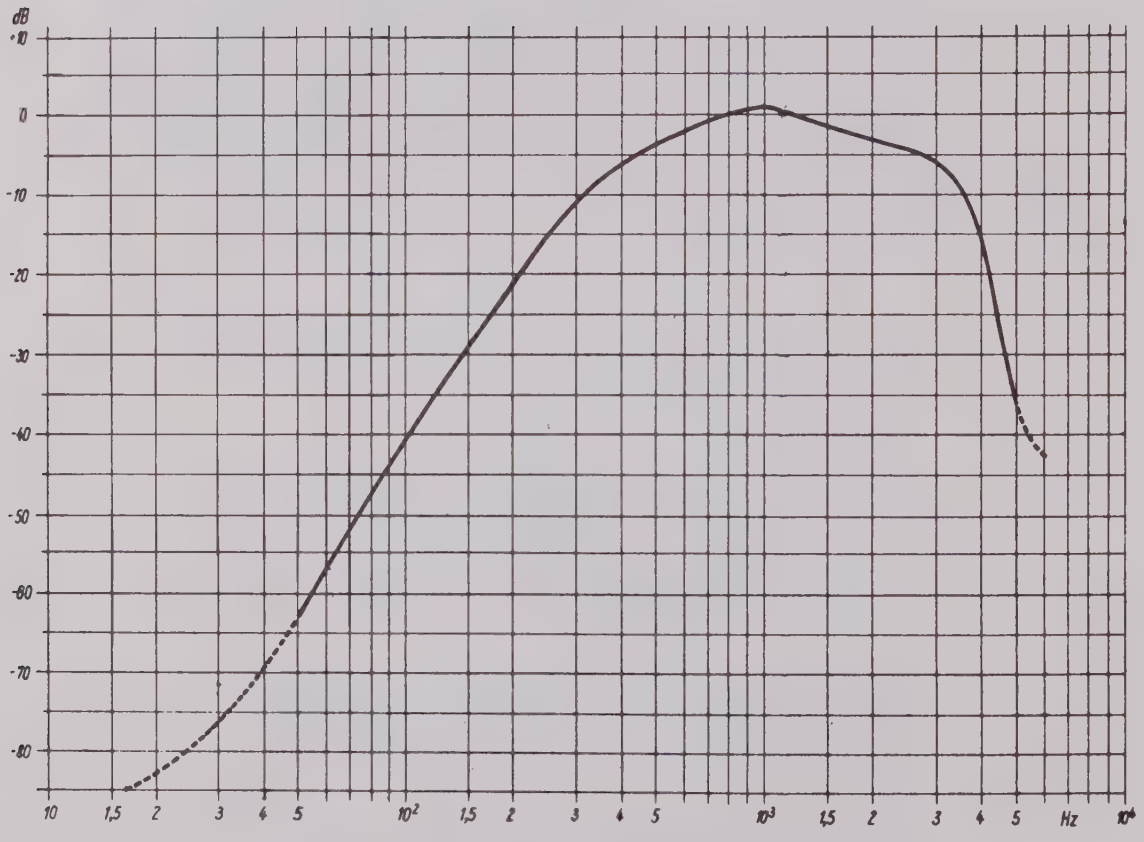
In the RECEIVER MEASUREMENT mode, counter displays the frequency applied to AF input (41) , if the f MOD (37) and f TRANSM (38) push buttons are depressed simultaneously.
Simultaneous actuating of the f OFFSET (35) and f MOD (37) push buttons causes increasing the resolution to 1 Hz for offset frequency measurements.

4.15 CCITT Weighting Filter

Actuating the WEIGHTING pushbutton (7) causes the psophometric weighting filter to be active for:

Noise modulation indication
AF millivoltmeter
Demodulated signal f MOD TRANSM
Distortion meter

The CCITT filter provides opjective weighting of parasitic and noise voltages in telephone frequency circuits, its characteristic being as follows for a reference frequency of 800 Hz.



CCITT Weighting Curve for measuring noise on telephone circuits

4.16 Sweep Mode

In the RECEIVER MEASUREMENT mode of the STABILOCK sweeping of carrier frequency may be accomplished via socket "+3.4 to +10.6 V ≙ Δf = +10 to -10 kHz" on the rear side of the instrument. This socket is destined for interconnecting the Type 4910 Analyser to the STABILOCK. The socket provides a DC voltage which is widely proportional to the frequency offset adjust by front panel controls (button f OFFSET (35) depressed).

A low impedance external source is required for sweeping. The source than will impress its own voltage into the socket and by this means swept frequency offset is caused on the STABILOCK.

Frequency response curves may be plotted with the aid of a X-Y recorder. For this the voltage from the socket must be applied to the (high impedance) X input of the recorder. Frequency offset and recorder deflection can be adjusted by front panel control FREQUENCY OFFSET (33).

Because of nonlinearity between the deflection voltage at socket "+3.4 to +10.6 V ≙ Δf = +10 to -10 kHz" and the offset frequency, the X-axis on the scope or recorder must be marked by a scale. The offset frequency indication on the counter (42) can be used to find out the relationship.

Specifications for socket "+3.4 to +10.6 V ≙ Δf = +10 to -10 kHz":

Deflection voltage internal or external impressed	+ 3.4 V ≙ Δf +10 kHz +10.6 V ≙ Δf -10 kHz
Source or input impedance	500 Ω approx.
Sweep rate	0 to 2 kHz/sec

5 FUNCTION DESCRIPTION

5.1 Receiver Measurement Mode

(refer Block Circuit Diagram RECEIVER MEASUREMENT, Page 5-5)

5.1.1 RF Section

When the instrument is switched to RECEIVER MEASUREMENT the RF section operates as a signal generator capable of being modulated, frequency synthesis being applied providing the frequency (see 5.3)

The synthesizer output (10 kHz . . . 480 MHz) is applied to RF DIRECT from the central mode switch positioned to RECEIVER MEASUREMENT via a 10×10 dB step attenuator.

The RF DIRECT socket is sensitive to overloads and must only be used for measurements requiring a high EMF.

It is usually the case that a link forms the connection from the RF DIRECT socket through a power attenuating pad (20 dB) to the RF N socket and on to the receiver input of the transceiver.

The power attenuating pad prevents damage of the STABILOCK calibration circuit when the transceiver is switched to TRANSMIT.

5.1.2 Modulation Adjustment

The STABILOCK synthesizer can be modulated by the internal modulation generator or by an external input.
In both cases adjustment of depth of modulation is achieved using the MODULATION control and a range switch. The modulation signal input to the range switch is rectified and used for indicating modulation.
Depending on the position of the modulation mode switch the modulation voltage is routed to the FM stage or the AM stage of the synthesizer. On φM a preemphasis pad is provided upstream of the FM stage.

5.1.3 AF Millivoltmeter

The AF millivoltmeter will indicate either the AF input or modulation generator output.

The AF input is guarded against hum pickup caused bei interconnecting a number of test instruments:
The exterior conductor of the AF socket is not directly coupled to ground but through a small resistance which produces an equivalent noise voltage to that of the interior conductor should hum be present.

The subsequent differential amplifier receives both signals in common mode thus compensating the hum.

The gain of the subsequent meter amplifier can be switched by the range switch of the millivoltmeter and the modulation mode selector. In FM and φM gain is reduced by 20 dB when the instrument is switched to RECEIVER MEASUREMENT.

Meter amplifier output is indicated following rectification by an true rms response rectifier when the AF or MOD GEN pushbutton is actuated, it being possible to previously include a weighting filter into the circuit.

5.1.4 Distortion Meter

If one of the pushbuttons DISTORTION or SINAD is actuated on the millivoltmeter panel, meter output is presented to the rectifier and subsequent indication only after inserting automatic LEVEL SET and a notch filter when the instrument is switched to RECEIVER MEASUREMENT.

The level set circuit has the task of maintaining the input to the notch filter constant for readings from 1/5 to f. s. d of the AF millivoltmeter.

The notch filter suppresses the 1 kHz fundamental. The harmonics together with any other parasitic frequencies are rectified subsequent to corresponding amplification and indicated as distortion or SINAD ratio.

5.1.5 Frequency Counter

When the instrument is switched to RECEIVER MEASUREMENT the counter will display accordingly:

Depressed Pushbuttons	
f MOD (37)	Modulation frequency
f OFFSET (35)	Vernier offset with respect to the channel frequency adjusted with the decade switch, resolution 10 Hz.
f Offset + f MOD	Vernier offset, resolution 1 Hz.
f TRANSM	Channel frequency adjusted with the decade switch, resolution 100 kHz.
f TRANSM + f MOD	Frequency applied to AF input (41).

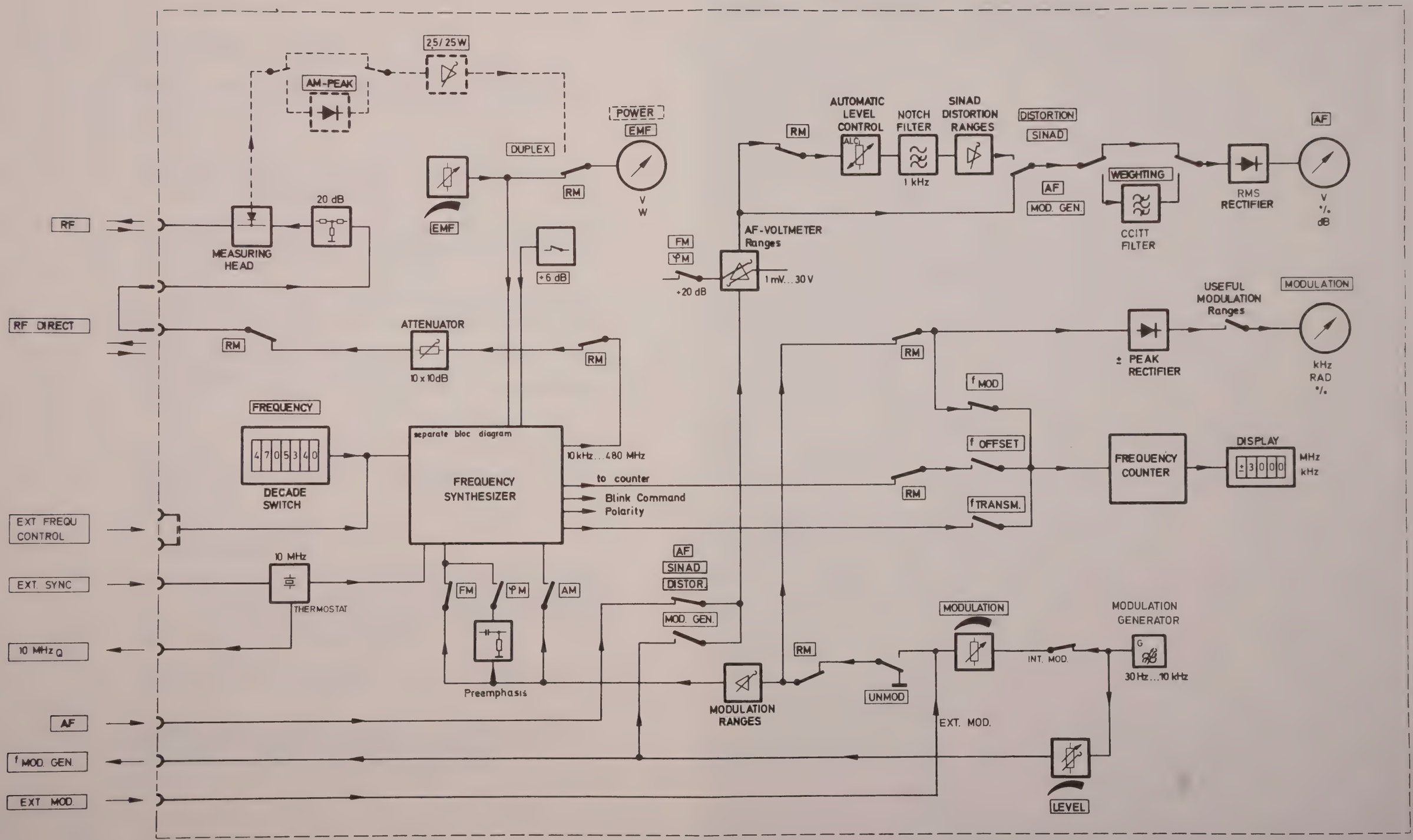
The counter is provided with commands from the synthesizer to blink display whenever transmitter input is too low or when the frequency range is exceeded and indication of vernier offset polarity (±). Counter display will also blink on f MOD $>$ 9.999 kHz.

In the RECEIVERMEASUREMENT MODE the sign of the counter display will blink if the f OFFSET button (35) is depressed. The blinking shall draw the operator's attention to an unwanted frequency offset adjustment.

5.1.6 DUPLEX Operation

DUPLEX operation is a special instance of instrument RECEIVER MEASUREMENT as inserted by actuating the RECEIVER MEASUREMENT and TRANSMITTER MEASUREMENT pushbuttons simultaneously.

In this mode the RF section continues to function as a signal generator but without EMF indication; the RF meter then displays transceiver transmitter output power.
Power indication results – as for instrument mode TRANSMITTER MEASUREMENT – with the aid of a rectifying detector inserted ahead of the RF socket.



RM = push button RECEIVER MEASUREMENT actuated

Block Diagram: RECEIVER MEASUREMENT Mode

5.2 Transmitter Measurement Mode

(Refer to Block Circuit Diagram TRANSMITTER MEASUREMENT, 5-9)

5 2.1 RF Section

The RF section operates as a power meter and test receiver in the TRANSMITTER MEASUREMENT mode.

Transceiver transmitter output is applied to the RF DIRECT connection from the RF connection through a rectifying detector and a 20 dB power attenuator pad to the front panel and cable link.

In the TRANSMITTER MEASUREMENT mode the RF DIRECT socket has the function of a test receiver input as caused by the position of the central mode selector switch.
The test receiver mainly comprises preamplifier, mixer, IF section and FM discriminator followed by the modulation meter stages.
The synthesizer then operates as a local oscillator with automatic IF offset (+ 2 MHz).

The rectified output of the rectifying detector serves to yield the power and AM indication.
A peak rectifier can be switched in for rectification to permit peak power indication on AM.

5.2.2 Modulation Indication

The demodulated output of the FM discriminator is routed via switchable meter amplifier for the useful and noise modulation ranges to the distortion meter, to the rectifer for modulation indication, to the f MOD TRANSM output to the counter and instrument speaker.

In the φM mode of operation deemphasis is inserted subsequent to the FM discriminator.

In the AM mode of operation demodulation is provided by the rectifier detector which is also used for indicating transmitter power. AM measurements via the RF DIRECT input are not possible.

The DC component of the rectifying detector output is maintained constant by AGC for power values from 0,2 to 25 W.
This facility eliminates the need of presetting carrier avarage power as is usual with measurements of depth of modulation.
An acoustically corrected weighting of noise is permitted by a filter meeting CCITT requirements which can be inserted in noise modulation meter ranges and the f MOD TRANSM output.

5.2.3 AF Millivoltmeter

Function as for operation in instrument RECEIVER MEASUREMENT.

5.2.4 Distortion Meter

When the instrument is switched to TRANSMITTER MEASUREMENT the distortion of the demodulated f MOD TRANSM output is measured at the output of the modulation meter amplifier. Measuring distortion at the AF input is not possible on instrument TRANSMITTER MEASUREMENT.

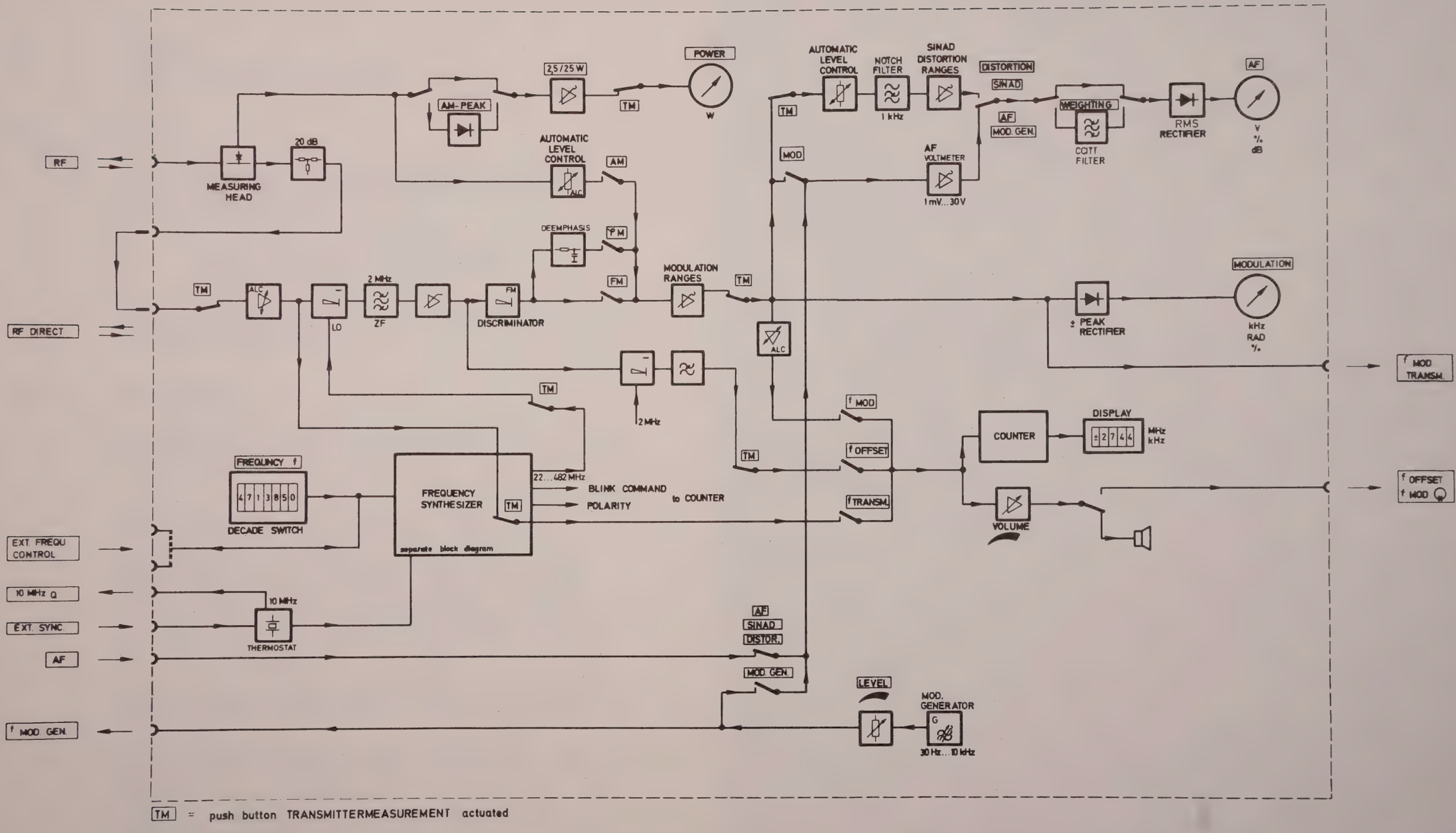
Function of distortion meter is otherwise as for RECEIVER MEASUREMENT.

5.2.5 Frequency Counter

Depending on pushbutton selection the frequency counter will display demodulated modulation frequency of the f MOD TRANSM transmitter, transmitter offset frequency f OFFSET or the transmit frequency itself.

To display the offset frequency the counter is provided with a signal obtained by demixing the IF with a 2 MHz crystal frequency.

For displaying the transmit frequency both the amplifier following the RF DIRECT connection and the frequency divider in the SYNTHESIZER are active.



TM = push button TRANSMITTERMEASUREMENT actuated

Block Diagram: TRANSMITTER MEASUREMENT Mode

5.3 Synthesizer

(See Block Circuit Diagram SYNTHESIZER – page 5-15)

5.3.1 General

The synthesizer contained in the STABILOCK is designed with 3 PLL (phase locked loop) control loops and 2 frequency control loops.
One PLL loop each is provided for:

main decade stage (1/10/100 kHz steps)
intermediate decade stage (10/100 kHz steps)
final decade stage (0,1/1 kHz steps)

An ext. sync 10 MHz crystal oscillator serves as the reference from which all auxiliary frequencies are derived.

5.3.2 Main Decade Stage

In the main decade stage the output frequency of the nondemixed frequency ranges (60 MHz) are generated with the aid of 5 oscillators which can be inserted as required and are designed for voltage control.

The oscillators are 'tied' to crystal frequencies derived from the intermediate decade and the 10 MHz reference oscillator as follows:
The oscillator output is routed through a controlled amplifier, a 64:1 frequency divider and a switchable low-pass filter to a mixer having the difference signal from the intermediate decade stage and the 10 MHz crystal stage at the other input. The mixer is followed by a frequency divider with an adjustable dividing ratio and a frequency comparison circuit and a phase bridge in parallel, the outputs of which (AFC, APC) control the oscillator reference.

The dividing ratio of the adjustable frequency divider is increased by 2 to yield the IF offset when the instrument is switched to TRANSMITTER MEASUREMENT.

RECEIVER MEASUREMENT: $n = 660 \ldots 1079 \triangleq f = 60 \ldots 479$ MHz
TRANSMITTER MEASUREMENT: $n = 662 \ldots 1081 \triangleq f = 62 \ldots 481$ MHz

The frequency comparison circuit, which is necessary to ensure a sufficiently wide pull-in range, contains an up/down counter followed by a D/A converter.

The choice of oscillator, divider adjustment and low-pass filter switching are all achieved by the decade switch for frequency adjustment or by remote control.

When the instrument is switched to TRANSMIT FREQUENCY MEASUREMENT, i.e. when pushbuttons TRANSMITTER MEASUREMENT and f TRANSM are operated the RF DIRECT output is directed to the control amplifier input instead of the voltage-controlled oscillators. The amplified output is routed through the 64:1 divider and a further 25:1 divider to the counter. If control amplifier input is insufficient a blink command is generated to cause the counter display to blink.

Frequency modulation is achieved with varactor diodes in the voltage-controlled oscillators. As a result of the lengthy time constants of the AFC and APC loops no disturbance of phase control occurs on FM.

5.3.3 Intermediate Decade Stage

The intermediate decade stage comprises a voltage-controlled oscillator which can be locked on to frequencies, with the aid of a phase control loop, which correspond to the 10 or 100 kHz lock points.

To this end the oscillator frequency is converted to an IF using the frequency divided by 100 of the final decade oscillator, the IF controlling the input of an adjustable frequency divider (n = 3960 . . . 4059). By comparing the divided frequencies with a frequency derived from the 10 MHz reference oscillator (3,125 kHz) the control voltage required for locking the oscillator is obtained.

Adjustment of the frequency divider is achieved by means of the decade switch for frequency adjustment or by means of remote control.

5.3.4 Final Decade Stage

The voltage-controlled oscillator of the finale decade stage can be locked-on with the aid of the adjustable divider (n = 4000 . . . 4099) and a phase bridge to frequency steps (each of 3,125 kHz) corresponding to the 0.1 of 1 kHz steps of the sythesizer output.

5.3.5 Vernier Offset

The vernier offset facility permits reliable adjustment of a constant vernier offset (f. OFFSET).

This highly constant adjustment is achieved by a frequency control loop which locks a voltage-controlled oscillator (10 ± 0,25 MHz) to a DC specified frequency. This is achieved by mixing the oscillator divided by 5 with the final decade oscillator frequency routed through two 5:1 dividers and a quadrupler and the resulting difference frequency applied to a frequency DC converter. Subsequent application to a differential amplifier holds the DC from the converter to the value specified by the f OFFSET adjustement control with subsequent control of the oscillator frequency.

For counter display of the vernier offset the counter receives the difference frequency, divided by 5, from the mixer output.

A digital frequency comparison circuit (larger — smaller) controls the +/— display of the frequency offset in the counter. When the instrument is switched to TRANSMITTER MEASUREMENT the comparison circuit receives the 2 MHz IF (see Block Circuit Diagram TRANSMITTER MEASUREMENT, page 5-9) and a 2 MHz frequency derived from the reference oscillator.

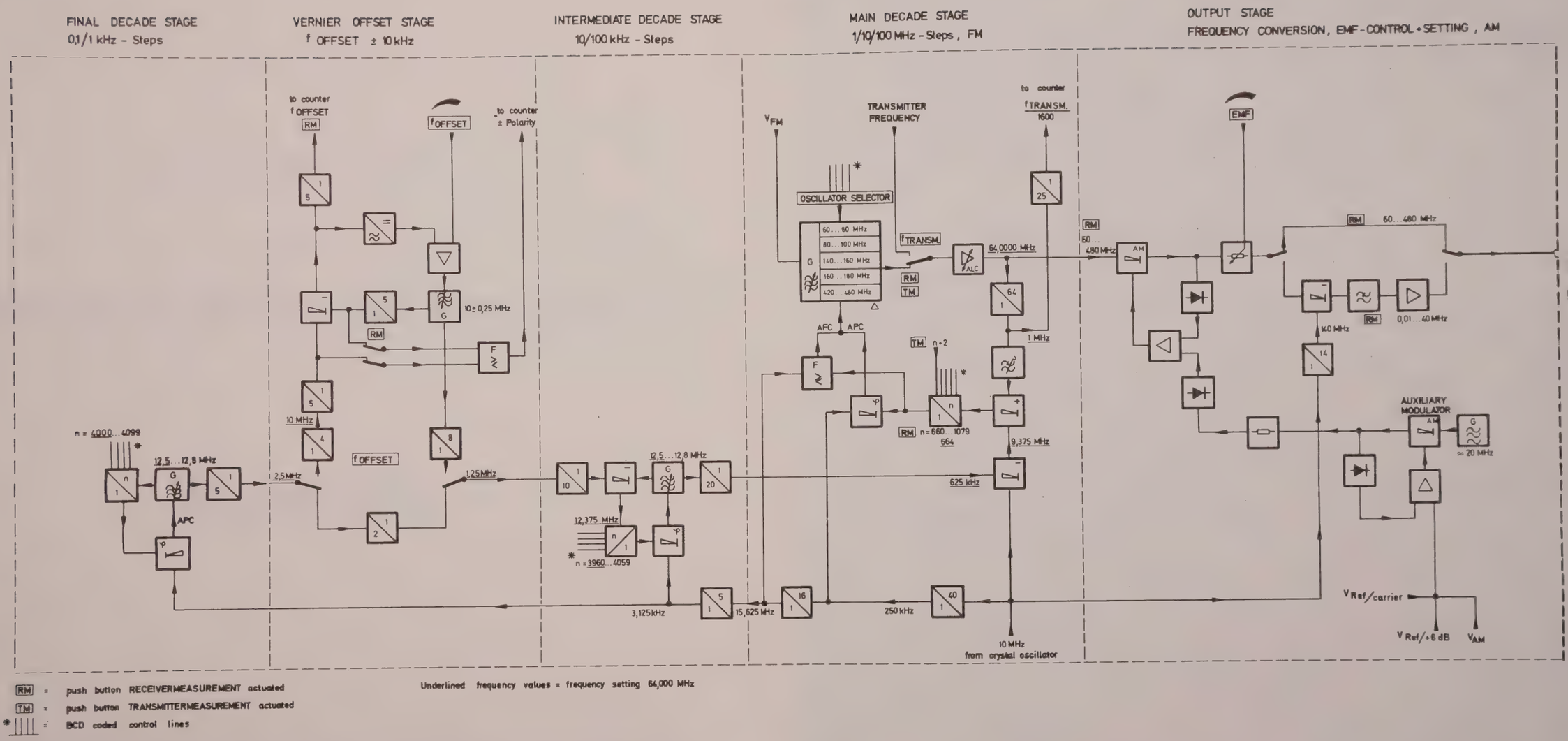
5.3.6 Output Stage

The output of the synthesizer provides amplitude modulation of the signals from the main decade stage, modulator output providing automatic control of the EMF.
This is done by a circuit arrangement which compensates non-linearities and temperature influences which occur during rectification of small RF signals.

First an auxiliary modulator (which provides a signal level high enough for satisfactory rectification) is amplitude modulated in a conventional manner using a differential amplifier and negative feedback. The RF signal being ideally modulated is then presented to a reference rectifier via a voltage divider, the rectifier having the same characteristics as the one used for EMF control. A differential amplifier is that the EMF tracks the RF voltage of the reference rectifier.
By increasing the reference DC to the input of the auxiliary modulator the EMF can be increased by + 6 dB.

The AM modulator is followed by a further PIN diode adjusting element for continuous 12 dB DC adjustment of the EMF.

This is followed by frequency conversion for the range 0.01 . . . 40 MHz with the aid of a 140 MHz LO frequency obtained from the 10 MHz reference oscillator.



RM = push button RECEIVERMEASUREMENT actuated
TM = push button TRANSMITTERMEASUREMENT actuated
* = BCD coded control lines

Underlined frequency values = frequency setting 64,000 MHz

Block Diagram: FREQUENCY SYNTESIZER

APPLICATION NOTES

for

Test Station for Radiotelephony Systems

Stabilock

Instruction:

On the 4020 series of the STABILOCK test set, the TRANSMITTER MEASUREMENT mode is selected automatically when the transmitter power exceeds 50 mW and if both the RECEIVER and TRANSMITTER MEASUREMENT buttons are released simultaneously. For this reason, if both buttons are in the released position, operating instructions of the application notes regarding these buttons may not be paid attention.
Exception: When measuring Duplex transceivers, both buttons must be pressed simultaneously as described on page 22.

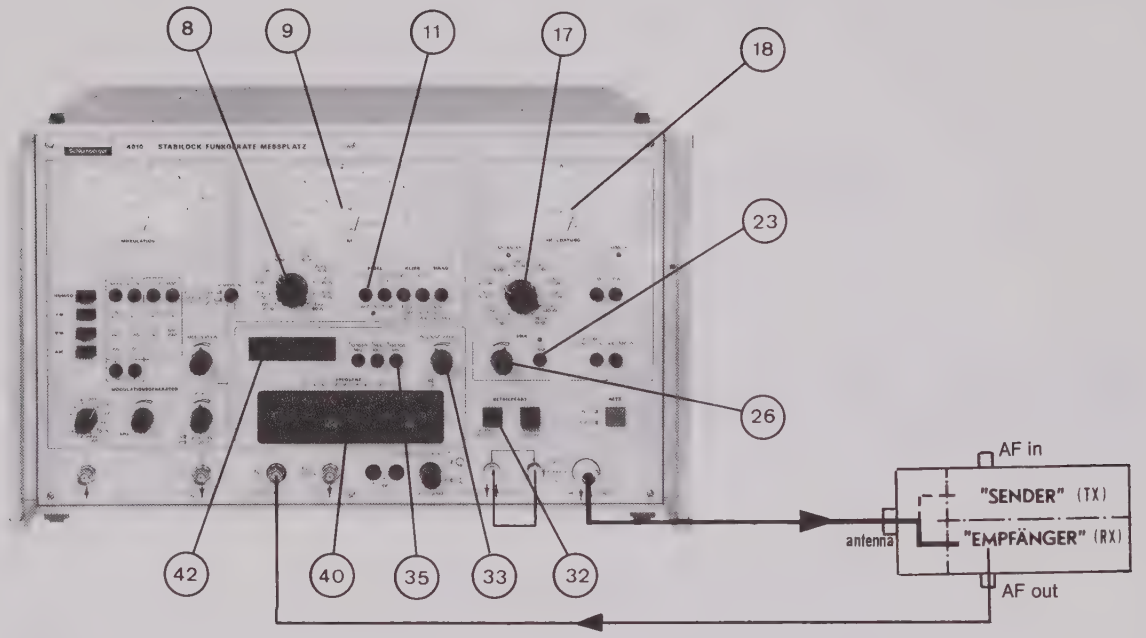
06.80

SCHLUMBERGER Meßgeräte GmbH
8000 München 60 · Ingolstädter Straße 67 a · Telefon 71 70 71

ENERTEC
Schlumberger

Receiver - bandwidth
Receiver - centre frequency

Test assembly



Measuring procedure

1) Set test mode "RECEIVER MEASUREMENT" (32)
2) Set carrier "FREQUENCY" (40). Set RF level to zero (17) and (26).
3) Select level measuring mode "AF" (11) and measure basic noise (8) and (9) with squelch switched off.
4) Increase RF output level (17), (18) and (26) for 10 dB noise suppression. Note this value!
5) Actuate "+ 6 dB"-push button (23) and set frequency measuring mode "f OFFSET" (35).
6) Tune pulled front panel control "FREQUENCY OFFSET" (33) till AF indication is the same as in 4).
   Counter indication (42) is corresponding to the lower cut-off frequency offset (Δf_1).
7) Tune pushed front panel control "FREQUENCY OFFSET" (33) till AF indication is again as in 4).
   Counter indication (42) is now corresponding to the upper cut-off frequency offset (Δf_2).
   Bandwidth = $|\Delta f_1| + |\Delta f_2|$ Centre frequency error = $\frac{|\Delta f_1| - |\Delta f_2|}{2}$
8) Adjusting of the receiver, if necessary:
   Adjust (33) until counter (42) displays half of the measured bandwidth ($\frac{|\Delta f_1| + |\Delta f_2|}{2}$). Adjust the receiver to the same millivoltmeter indication (9) as found by 4). Check again by 6) and 7).

COMMENT

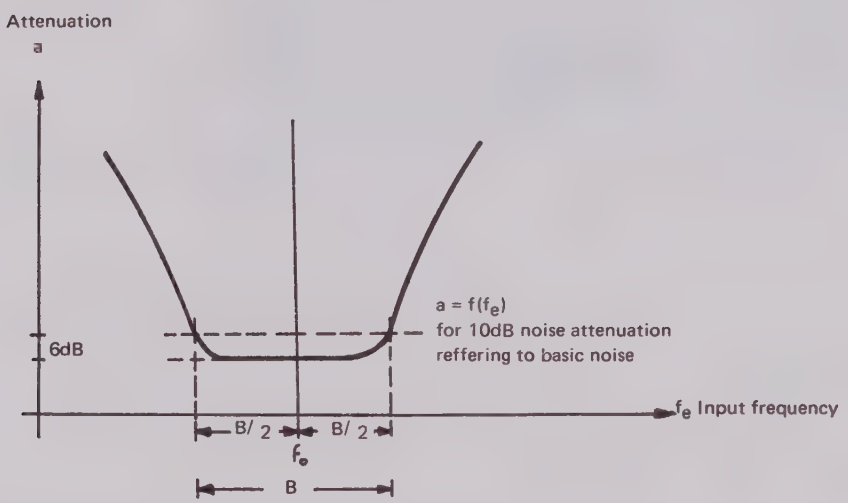
Sometimes the receiver center frequency is measured by determination of the zero axis crossing of the discriminator output.
But the result of this measurement can be inaccurate as a result of:

a) the temperature dependence of the discriminator

b) the inaccuracy of the zero-indicator

c) the differences in electrical parameters of the discriminator diode-pair.

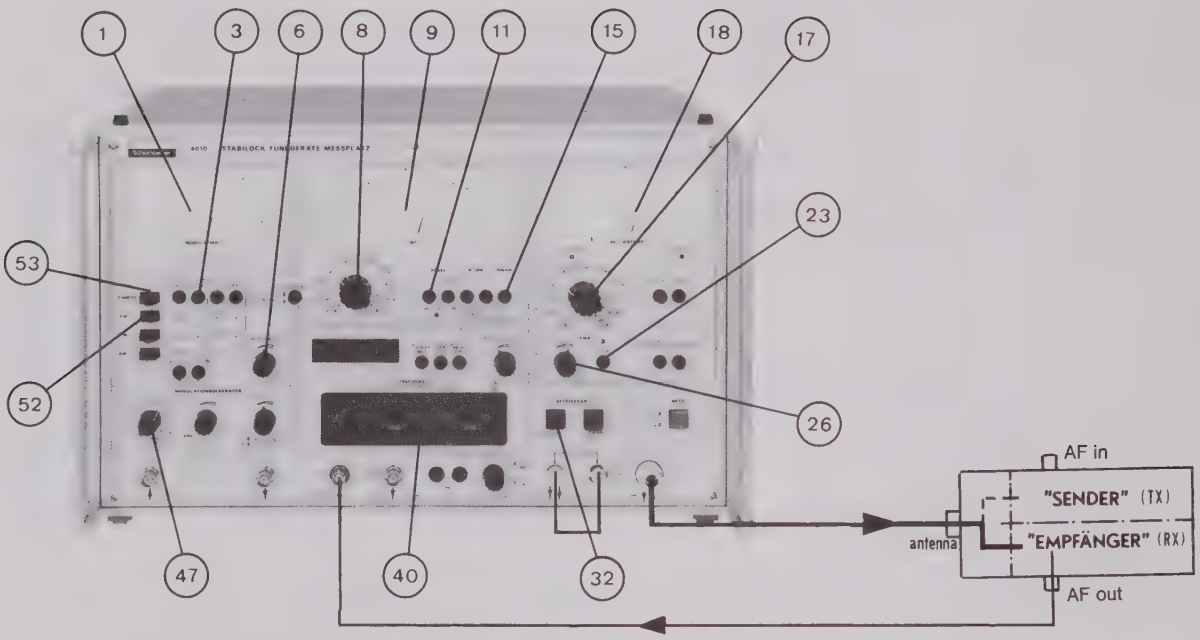
The CEPT specified bandwidths of some kHz, which only are to measure with the described method.



The diagram shows the attenuation characteristic of a receiver as a function of the input frequency.

Receiver sensitivity
Squelch threshold

Test assembly



Measuring procedure

SENSITIVITY MEASUREMENTS

20 dB S/N Methode

The sensitivity of a receiver is the EMF with specified modulation at the receiver's input which will produce at the receiver output a 20 dB of signal to noise ratio.

1) Set test mode "RECEIVER MEASUREMENT" (32) and carrier "FREQUENCY" (40).
2) Set RF output level (EMF) to 10 µV (17) and (18).
3) Modulate carrier:
   modulation mode "FM" (52)
   modulation frequency "1 kHz fixed" (47)
   frequency deviation "2,8 kHz" (6) and (1) and (3)
4) In level measuring mode "AF" (11) the AF level of the receiver output is indicated by the AF millivoltmeter (9).
   Note indication value!

5) Switch off modulation (53) and reduce RF output level (17) and (26) till AF level indication (9) is equal point 4).
If it is switched between modulation mode "FM" (52) and "UNMOD" (53) AF level indication has to be constant.
(If modulation is switched off the sensitivity of the RF millivoltmeter is increased automatically by 20 dB).
Then the receiver sensitivity = EMF value set on the STABILOCK.

SINAD Methode

Sensitivity = RF input EMF (of a carrier with standardised modulation) which is required to achieve in the demodulated AF output a ratio

$$\frac{\text{SIgnal + Noise And Distortion}}{\text{noise + distortion}}$$

of 12 dB (or 20 dB whatever being specified).

1) to 3) as described above in 20 dB S/N Methode 1) to 3).

4) Check AF-level from the transceiver with millivoltmeter (9) (8).
Pointer deflection must be within 20 % (marker ó) and 100 % of the indicating range.

5) Set distortion measuring mode "SINAD" (15).

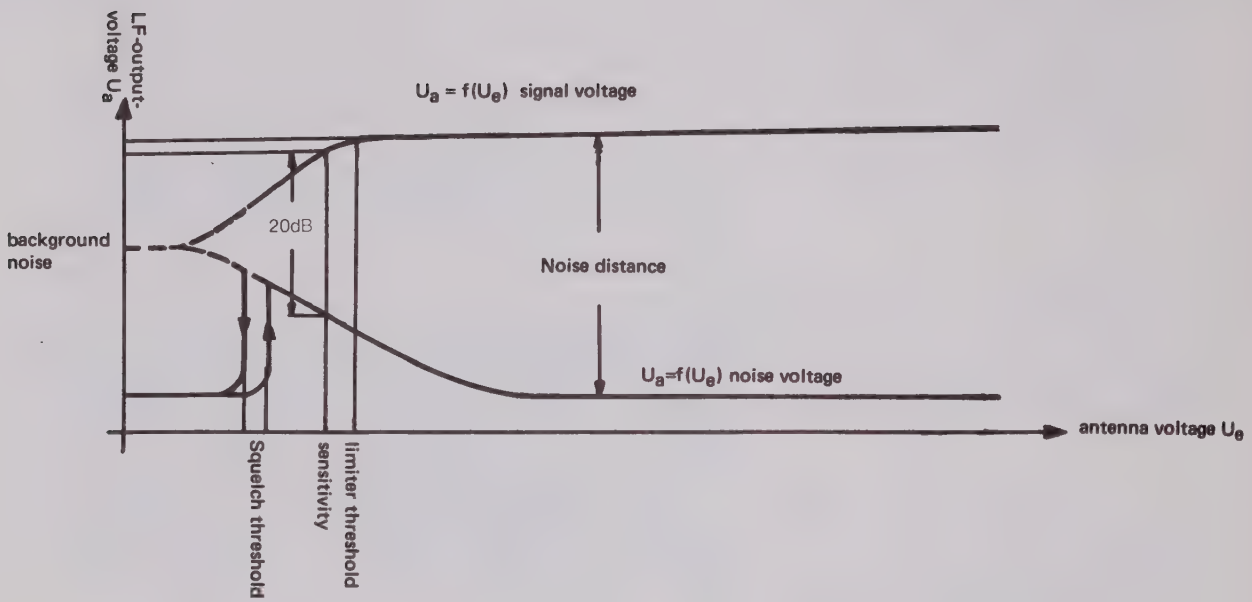
6) Reduce RF output level (17) and (26) till pointer of distortion meter (9) shows "12 dB SINAD" or "20 dB SINAD".

7) The set RF output level is now equal to the sensitivity of the receiver.

SQUELCH THRESHOLD

1) Set test mode "RECEIVER MEASURMENT" (32) and carrier frequency (40).
Switch on squelch of receiver

2) Increase RF output level (17) and (26) slowly from zero till noise is audible or the pointer of the AF millivoltmeter (9) is jumping to the higher value.
The set RF output level is equal to the squelch threshold value.



Typical diagram of a
Radiotelephony set

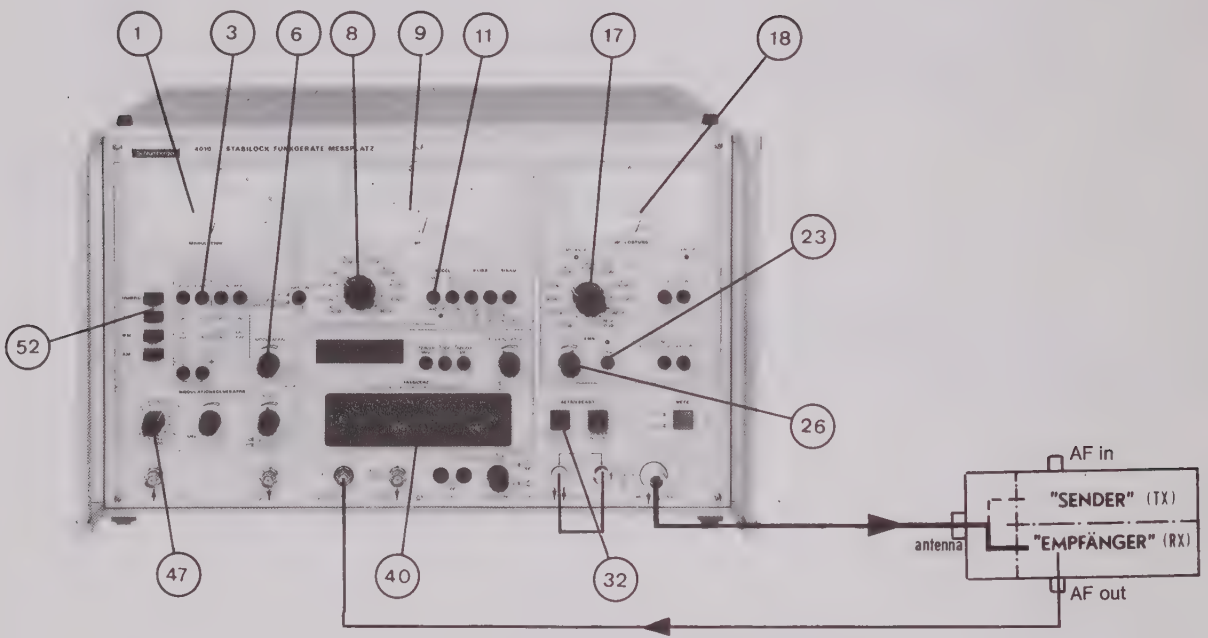
Signal- and noise voltage as a function of the antenna voltage

The LF way is blocked at switched on squelch in order to avoid the noise if the antenna signal is too small or if the carrier is missed. The sensitivity is defined as this antenna voltage of a receiver which results in a 10 : 1 voltage ratio (20dB signal-to-noise ratio) of the modulated (f_{mod} = 1kHz, f = 60 % of maximum deviation) to the unmodulated carrier. The signal-to-noise ratio increases up to a maximum value, if the antenna voltage is increased.

That means, if an unmodulated carrier is received the LF does not come to a lower value and on the other hand the signal voltage – caused by the modulation – does not increase. The point at which the signal voltage becomes horizontal is the beginning of the limitation.
In the special cases the values of the manufacturers are to attend.

AF frequency response

Test assembly



Measuring procedure

1) Set test mode "RECEIVER MEASUREMENT" (32).

2) Set carrier frequency (40) and increase RF output level 20 dB higher as nominal sensitivity (17), (18) and (26).

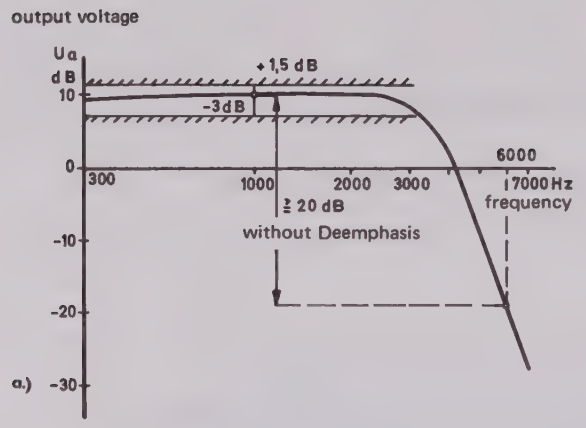
3) Modulate carrier:

modulation mode	"FM" (52)
modulation frequency	"1kHz fixed" (47)
frequency deviation	"2,8kHz" (6) and (1) and (3)

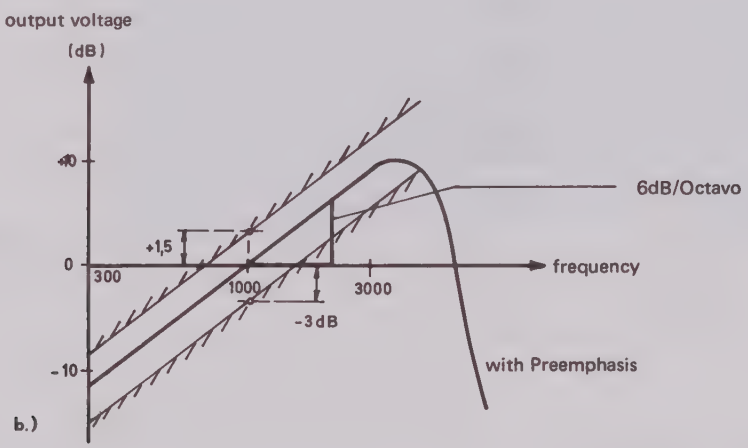
4) In level measuring mode "AF" the AF level of unit under test is indicated by millivoltmeter (9).
Note value!

5) Vary modulation frequency (47) and notice the indication of the AF millivoltmeter.
(Nominal values see manufacturer's specifications.)

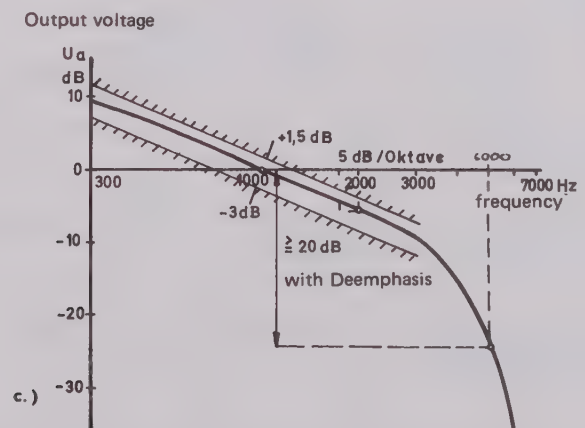
COMMENT



a) The diagram shows the typical low frequency response of a FM-receiver (constant loudness level over the whole speech band at constant modulation level). In phase modulated receivers the LF-output signal must have the same characteristic.



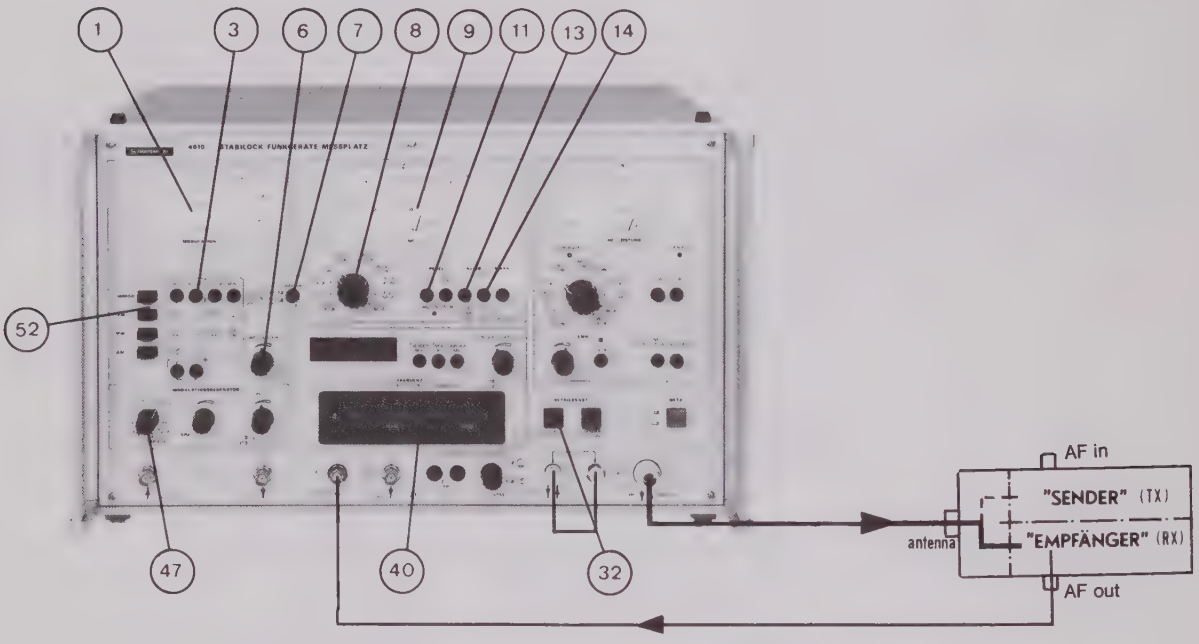
b) According to the characteristic of a phase modulator the high frequency response is not independent of the LF any more but increases at a rate of 6dB/octavo (one octavo = a frequency step to the double value). This characteristic is called **Preemphasis.** The relation between low frequency and the LF-output level of a phase modulated transmitter (or a frequency modulated transmitter with a preemphasis inserted before the modulator) is shown in figure b).



c) The preemphasis has to be eliminated by a deemphasis (the characteristic of this deemphasis is shown in figure c), because without compensation the phase-modulated signal is not intelligible.
The diagrams show the frequency response tolerances permitted by the German Bundespost referred to 1kHz modulation frequency and 70 % of the maximum frequency deviation. The damping of =20dB at 6kHz should be a criterion for the decrease of the frequency above the speech band.

Demodulation distortion

Test assembly



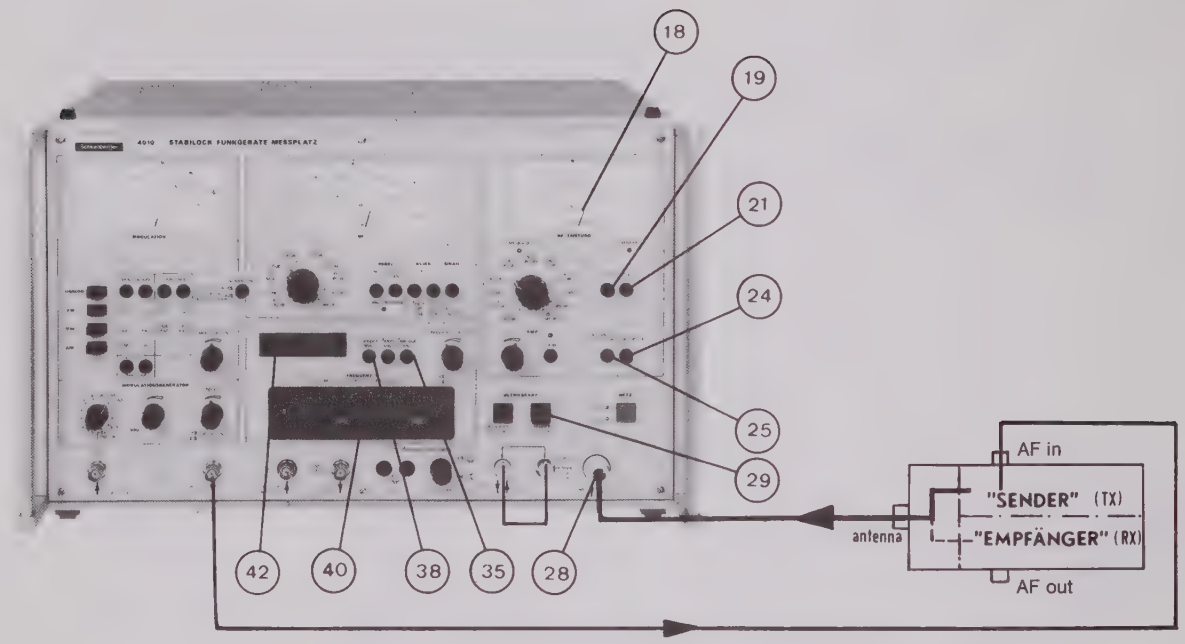
Measuring procedure

1) Set test mode "RECEIVER MEASUREMENT" (32) and carrier frequency (40).
2) Tune RF output level to 20dB above measured sensitivity (approx. 10µV). (See R-2, A) 1) to 5)).
3) Modulate carrier:
   modulation mode "FM" (52)
   modulation frequency "1kHz fixed" (47)
   frequency deviation "2,8kHz" (3) and (6) and (1)
4) Check AF-level (9) (8) . Pointer deflection must be within 20 % (marker ⏚) and 100 % of the indicating range.
5) * In measuring mode "30%" (13) or "10%" (14) the distorion factor is indicated by the distortion meter (9).

   *(The distortion factor may also be measured weighted if push button (7) "WEIGHTING" is actuated).

Transmitter frequency
Transmitter power

Test assembly



Measuring procedure

1) Set test mode "TRANSMITTER MEASURING" (29).
2) Set frequency measuring mode "f TRANSM" (38).

   Carrier frequency is now indicated by the internal counter (42) with a resolution of 100kHz.

3) Set the counter value at decade switches "FREQUENCY f" (40) and select frequency.measuring mode "f OFFSET" (35).

   The frequency offset between transmitter frequency and set value (40) is indicated now by the counter (42)
   and may be brought to zero by frequency setting (40). The set frequency is equal to the carrier frequency of the transmitter.

   The beat between the two frequencies is additionally audible via internal laudspeaker or headphones.

4) * Select desired power measuring range "2,5W" (19) (f. s. d.) or
   "25W" (21) (f. s. d.)

   The transmitter power is then indicated by the power meter (18).

   * Power measurement is only possible via high level input (28).

COMMENT

Carrier frequencies

The allocation of carrier frequencies for land mobile radio services differs from country to country. In UK and continental Europe the most often used bands are approximately between 70 and 90MHz, 150 and 175MHz, 430 and 470MHz. The channel separation will be 20kHz in Germany and partially in France and 25kHz or 12,5kHz in all other countries. Channel separations of 50kHz are still in use in France and in most military systems (27 to 70MHz and 225 to 400MHz).

The application engineer has to make sure that he gets all the specifications which are valid in his area from his General Post Office or the Ministry of Post and Telecommunication.

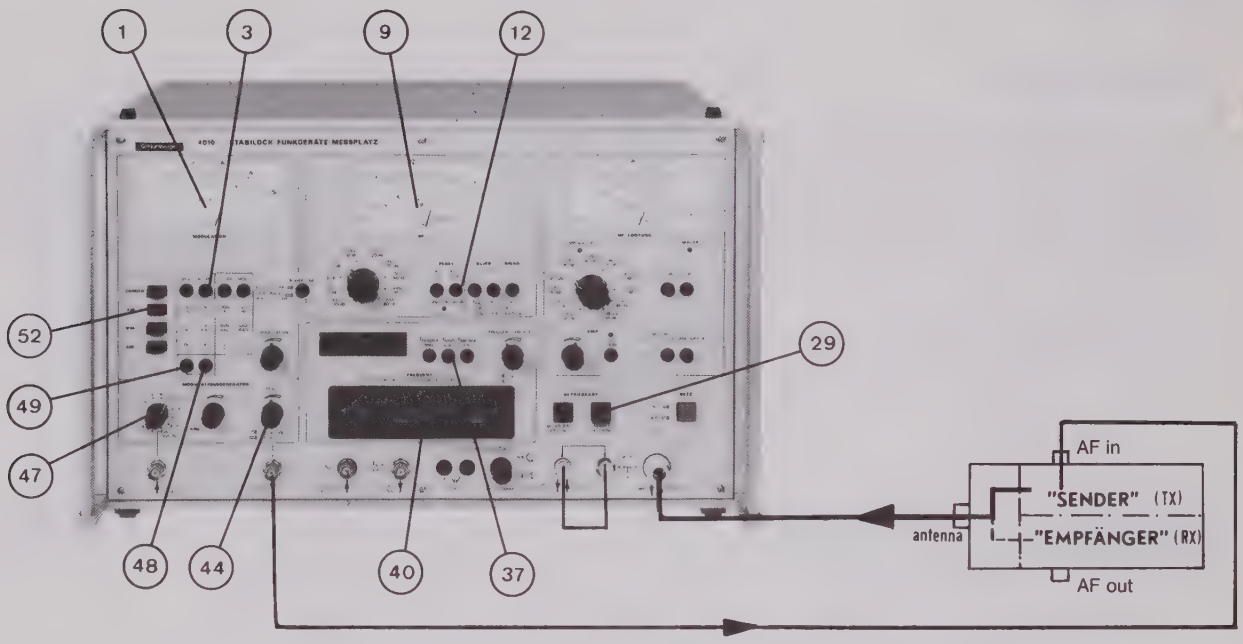
A present proposal made by the members of the "Conference of European Postal and Telecommunication Administrations" called CEPT is given below.

	Frequency Tolerance (kHz)			
Channel Separation (kHz)	Below 50MHz	50 to 100MHz	100 to 300MHz	300 to about 500MHz
20 and 25	±0.6	±1.35	±2.0	±2.5
12.5	no specification	±1.0	±1.0 (B) ±1.5 (M)	±1.0 (B), (M)

B = base station M = mobile station

Frequency deviation / - deviation limitation

Test assembly



Measuring procedure

1) Set test mode "TRANSMITTER MEASURING" (29) and carrier frequency (40). Set frequency measuring mode "f MOD" (37).

2) Modulate transmitter:
   modulation frequency "1kHz fixed" (47)
   modulation mode "FM" (52)

3) Select level measuring mode "MOD. GEN." (12).

4) Increase AF output level (44) till the nominal frequency deviation value (2, 8kHz) is indicated by modulation meter (1).
   The indicated AF level should correspond to the specifications of the manufacturer (for example: 4mV).

5) In order to measure the deviation limitation increase AF output level (44). The deviation will not increase any more from a certain AF level on.

   If the max. frequency deviation is $\leqq$ the manufacturer's specification the function of the limiter is correct.

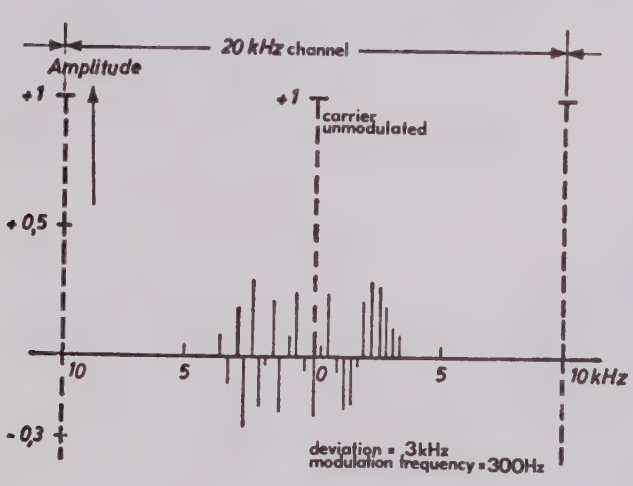
6) Positive or negative deviation indication may be selected by push buttons (49) and (48). If both are pressed the meter indicates $\frac{\Delta f+ \; + \; \Delta f-}{2}$

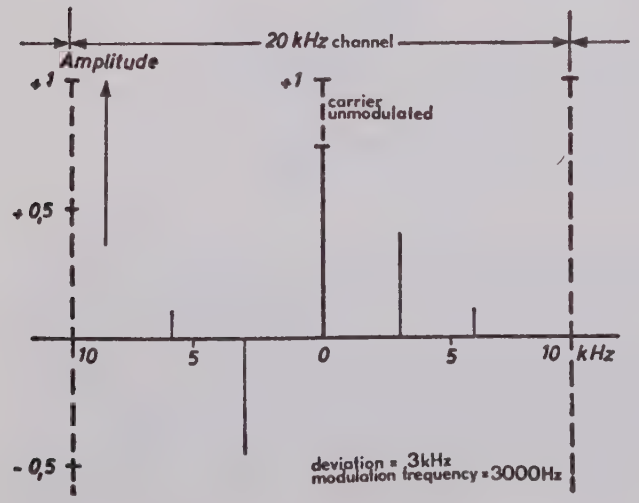
COMMENT

The maximum permissible frequency deviation depends on the channel separation and ist given in the table below.

Channel Separation (kHz)	Maximum Permissible Frequency Deviation (kHz)
25	±5
20	±4
12.5	±2.5

The normal test modulation according to the CEPT paper is 60 % of the maximum permissible modulation, but this proposal is not yet valid, instead still we have: In UK 50 %, in France 75 %, in Germany 70 %. In order to avoid interference of communication in the adjacent channel, overmodulation of the transmitter has to be avoided. This means that the sidebands produced by the modulation process must not reach in to the frequency band of the adjacent channel.

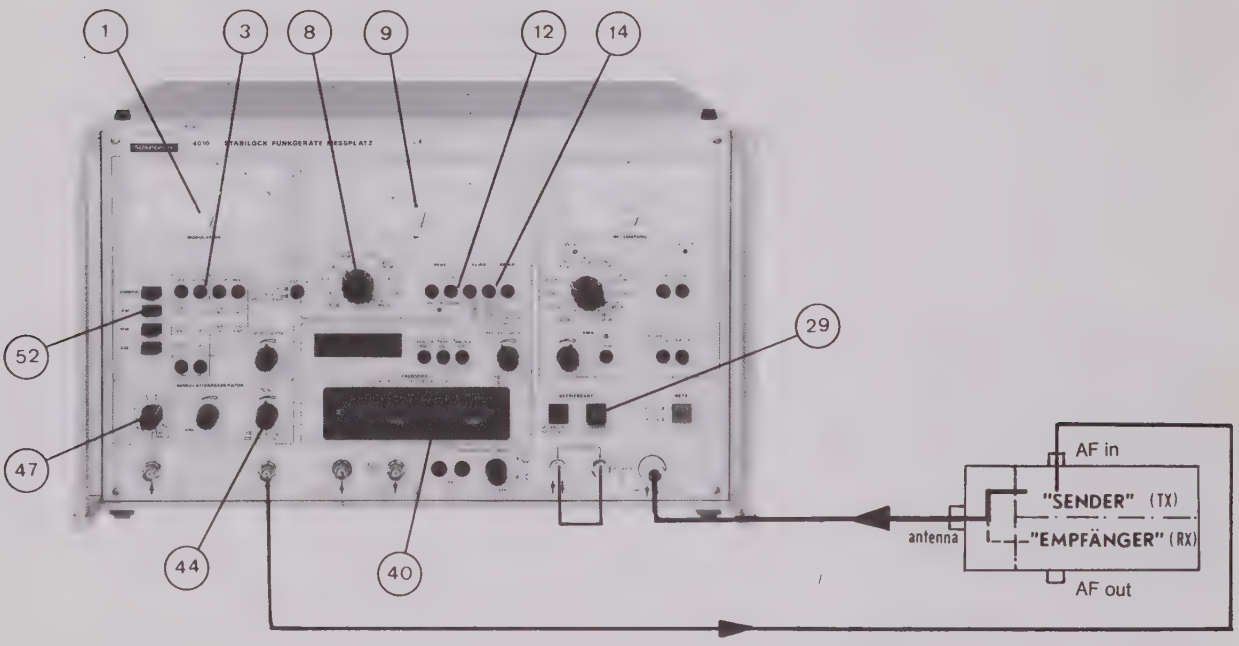




The figures show the frequency spectrum of a carrier modulated by a frequency of 300Hz or 3kHz resp. and a deviation of ±3000Hz in both cases. One can see that the number of harmonics of the modulation frequency produced by the frequency-(resp.phase-) modulation process depends on the ratio between deviation swing (±3kHz in both cases) and the modulation frequency (300Hz and 3kHz resp.). This means the swing of the frequency deviation has to be reduced at higher modulation frequencies in order to get a lower ratio $\Delta f/f_{mod}$ to avoid the production of harmonic sidebands at the higher modulation frequencies. Therefore all administrations have specified regulations for the limitation of the modulation sidebands. It is obvious that the number of sidebands will be increased, when the modulation characteristic is asymmetrical. In this case a second harmonic of the modulation signal will be produced, which can easily reach an unacceptable value of the corresponding modulation sideband outside the allocated band.

Modulation frequency response / - distortion factor

Test assembly



Measuring procedure

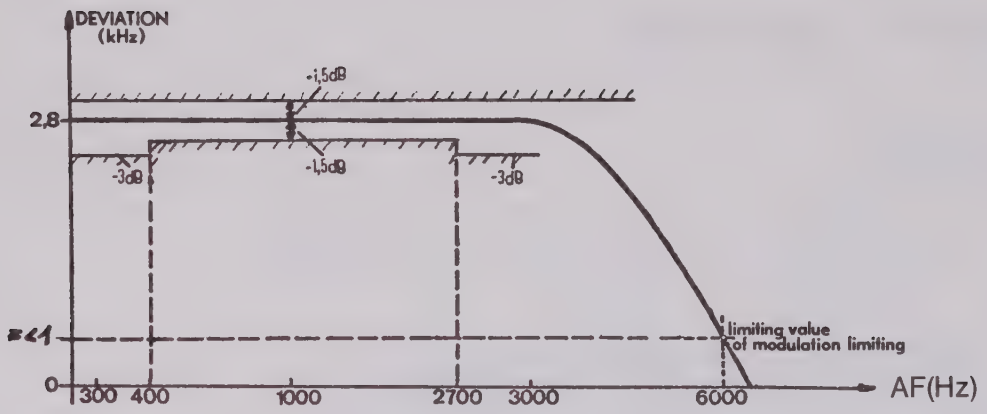
1) Set test mode "TRANSMITTER MEASURING" (29) and carrier frequency (40). Do not press button "f TRANSM."

2) Modulate transmitter:
   modulation mode "FM" (52)
   modulation frequency "1kHz fixed" (47)
   frequency deviation "2,8kHz" (44), push (3), read (1).

3) Change the modulation frequency (44) and keep a constant deviation indication (1), tunable with frontpanel control (44).
   The frequency response related to 1kHz is now indicated in "dB" by the millivoltmeter in level measuring mode "MOD. GEN." (12).

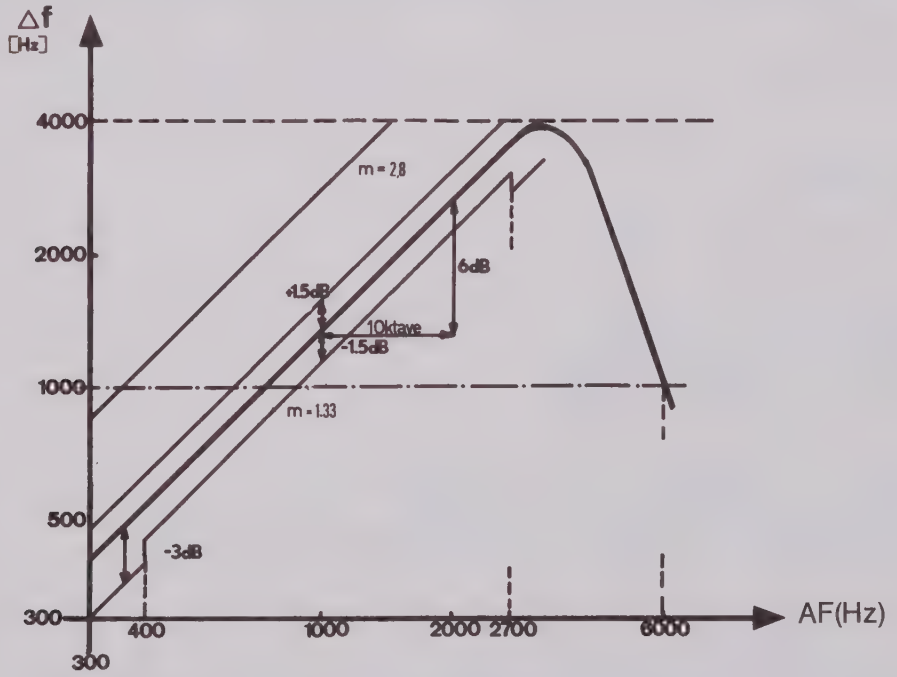
4) Set modulation frequency back to "1kHz fixed" (47) and select distortion range "10%" (14) (or "30%" (13)).
   The distortion factor for 1kHz f MOD. is now indicated by distortion meter (9).

   On modulation distortion measurements, pionter deflection of the modulation instrument (1), must be within 20 % (marker ó) and 100 % of indicating range.



As explained above it is necessary to avoid any modulation of the transmitter with frequencies which can produce sidebands in the adjacent channels.

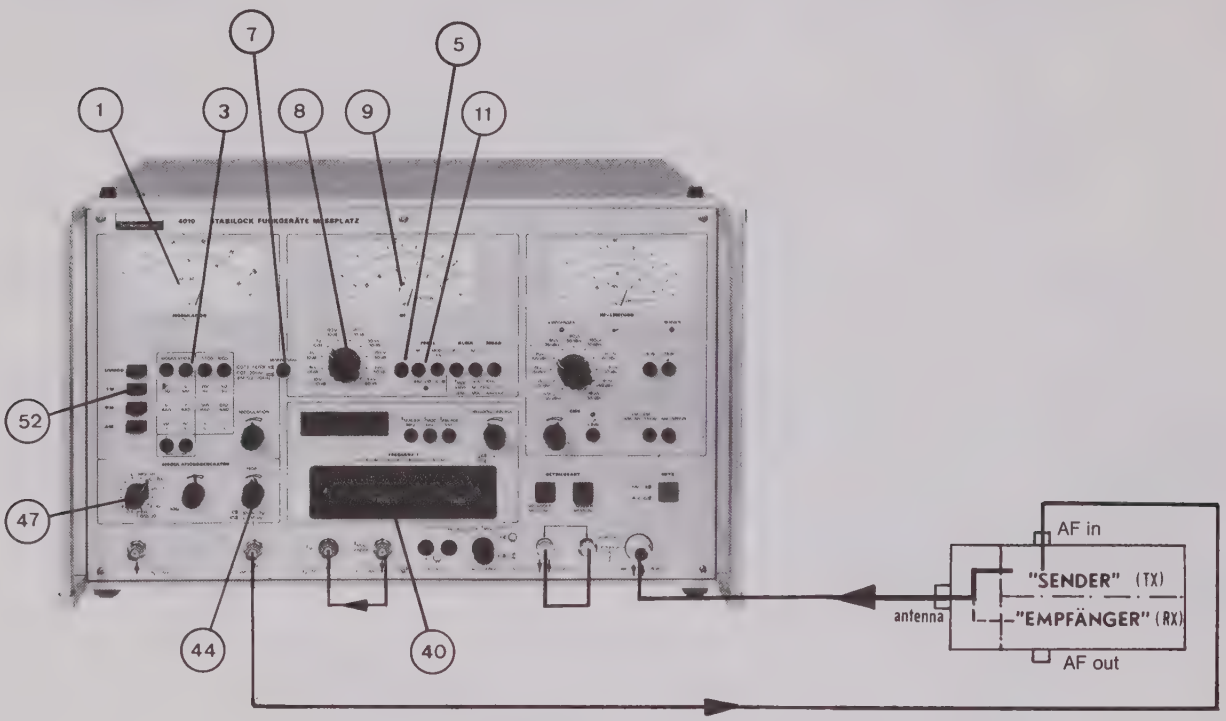
To avoid this interference, all administrations have issued regulations for the limitation of the frequency response. The CEPT proposal defines that when modulating with a constant audio input level, the deviation for 6kHz modulation frequency shall be at least 6dB below the deviations at a modulation frequency of 1kHz at the same audio input level. At modulation frequencies above 6kHz, the frequency response of the deviation should have a slope of at least 14dB/octave.
The figure above shows the characteristic of the frequency response of modulation with the tolernace requirements of the German Post Office.



Phase modulated transmitters present preemphasis characteristics, the deviation increases at 6dB per octave, i. e. the deviation increases to the double value for every doubling of the modulation frequency. One has to take into consideration that there is a deviation limiter (e. g. maximum deviation 4kHz at channel spacing of 20kHz). Thus in order to check the linearity of the preemphasis a modulation index ($m = \frac{\Delta f}{fmod}$) should be set which results in the maximum deviation at 3000Hz modulation frequency (e. g. m = 1,33). The setting $\Delta f = 2{,}4kHz/f_{mod} = 1kHz$, which is proper for FM checking is disadvantageous as deviation limiting begins at a modulation frequency of 1670Hz. Beyond the speechband the deviation has to decrease, as at FM. The requirements of linearity and limiting will be found in the manufacturers data.

Signal - to - noise ratio

Test assembly



Measuring procedure

1) Set carrier frequency (40)

2) Set controls for measurement of transmitter modulation:
Modulation mode FM (52)
FM deviation range 5 kHz (3)
Actuate the CCITT filter (7)

3) Modulate the transmitter of the unit under test:
Modulation frequency 1 kHz (fixed) (47)
Adjust generator level (44) for 2.8 kHz FM deviation (1)

4) Press the MOD button (5) for indication of the transmitter modulation by the AF voltmeter.
Corresponding to 2.8 kHz FM deviation the voltmeter will indicate 0.56 V (resp. - 2.8 dB) if the modulation distortion is negligible.

5) Switch off modulation ((47) to unmarked position).
Read the spurious transmitter modulation from the AF voltmeter, e.g. - 42 dB.

Signal to noise ratio:
(S+N) / N = dB difference between wanted and spurious FM deviation
= - 2.8 dB - (- 42 dB) = 39.2 dB

Conversion of voltmeter reading into FM deviation:

Spurios FM (Hz) = modulation sensitivity (Hz/mV) x voltmeter reading (mV)

Modulation sensitivity: 20 Hz/mV in the 20 kHz measurement range (2)
5 Hz/mV in the 5 kHz measurement range (3)
2 Hz/mV in the 2 kHz measurement range (4)

Example: Reading 26 mV, Measurement range 2 kHz
Spurious FM = 2 Hz/mV x 26 mV = 52 Hz

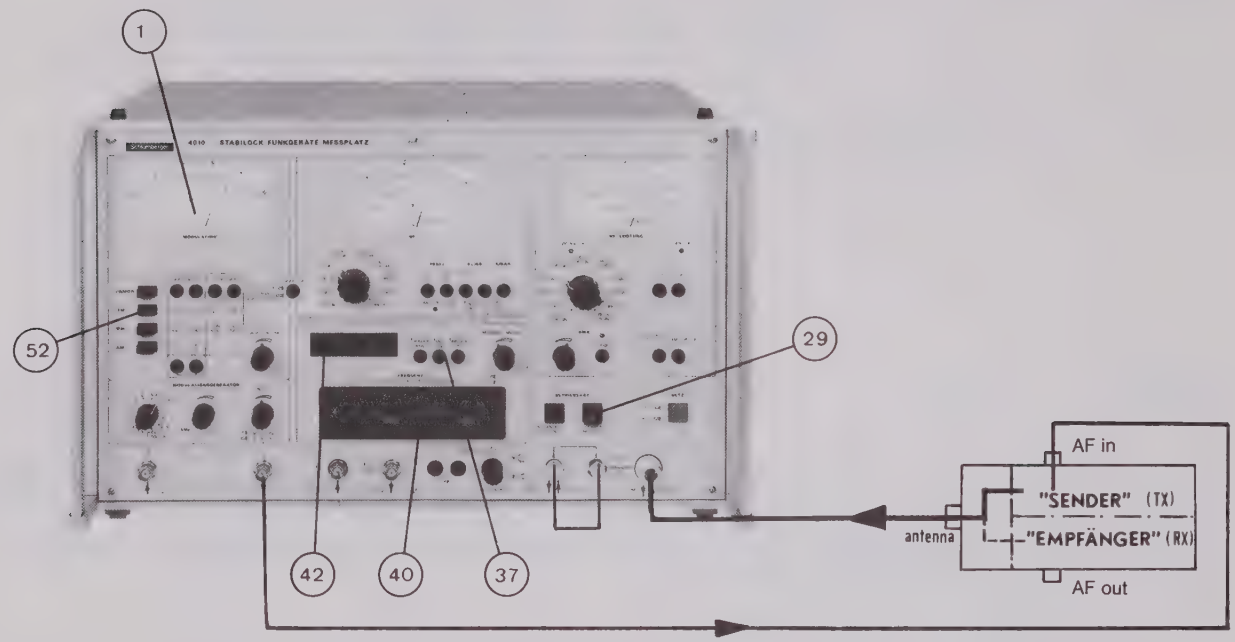
COMMENT

The transmitter has to have a minimum value of the noise-ratio which has to be specified by the manufacturer.
The S/N-ratio is the relation between the value of the unmodulated carrier (noise), measured with a discriminator and the value of the modulated carrier.

modulation frequency = 1kHz
deviation = 60 % of the permissible deviation

Call tone frequency/ - deviation

Test assembly



Measuring procedure

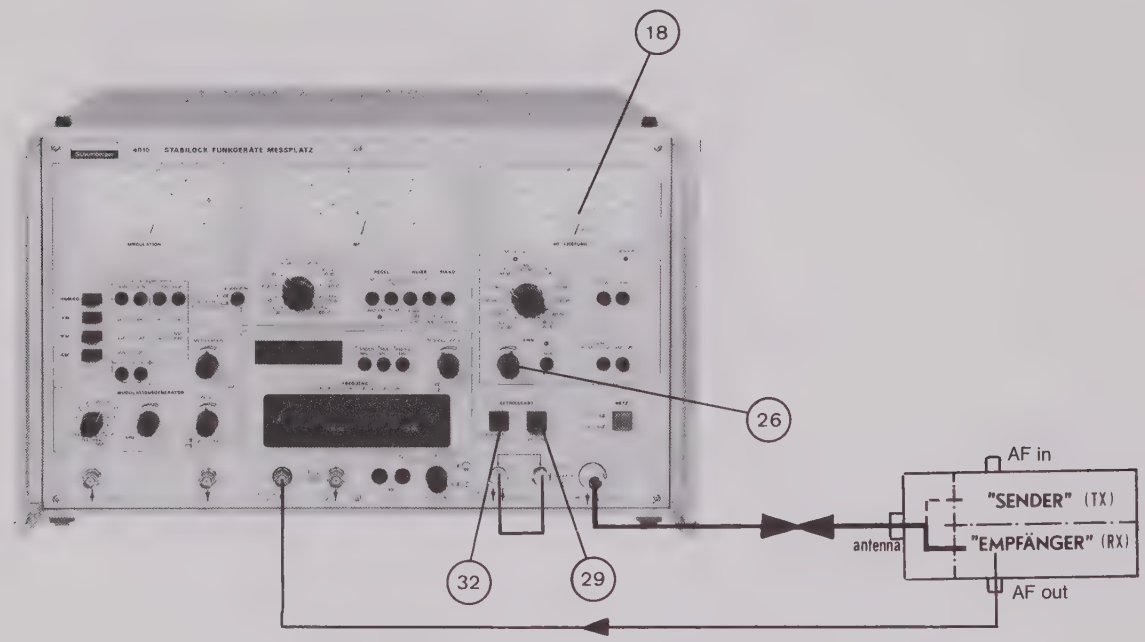
1) Set test mode "TRANSMITTER MEASURING" (29) and carrier frequency (40).

2) Set modulation mode "FM" (52) and
frequency measuring mode "f MOD" (37).

3) Push tone calling key of the transmitter.
The call tone frequency is indicated by the counter (42) with a resolution of 1Hz.
The deviation is indicated by the deviation meter (1).

Measuring of separating filters in radiotelephony sets for duplex operation

Test assembly



Measuring procedure

1) Measure receiver sensitivity according R-2 step 1 to 5.
2) Switch in both test modes "TRANSMITTER MEASUREMENT" (32) and "RECEIVER MEASUREMENT" (29) by pushing both buttons simultaneously and push the transmitter key.
3) Set RF output level (26) in order to achieve the same AF indication value as in step 1).
4) Push button (32) so that button (29) releases and note new RF output level (18) .
   Difference between RF level of step 1) and step 4) is a measure for the attenuation of the antenna separating filter.

   Note: As in the test mode described in step 2) the signal generator and the power meter is actuated together, the transmitter- and receiver- sections of the duplexer filter may be aligned.

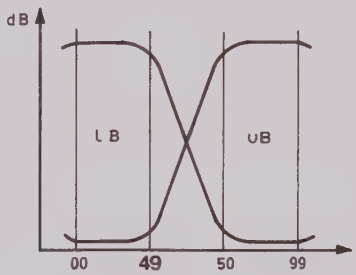
ATTENTION

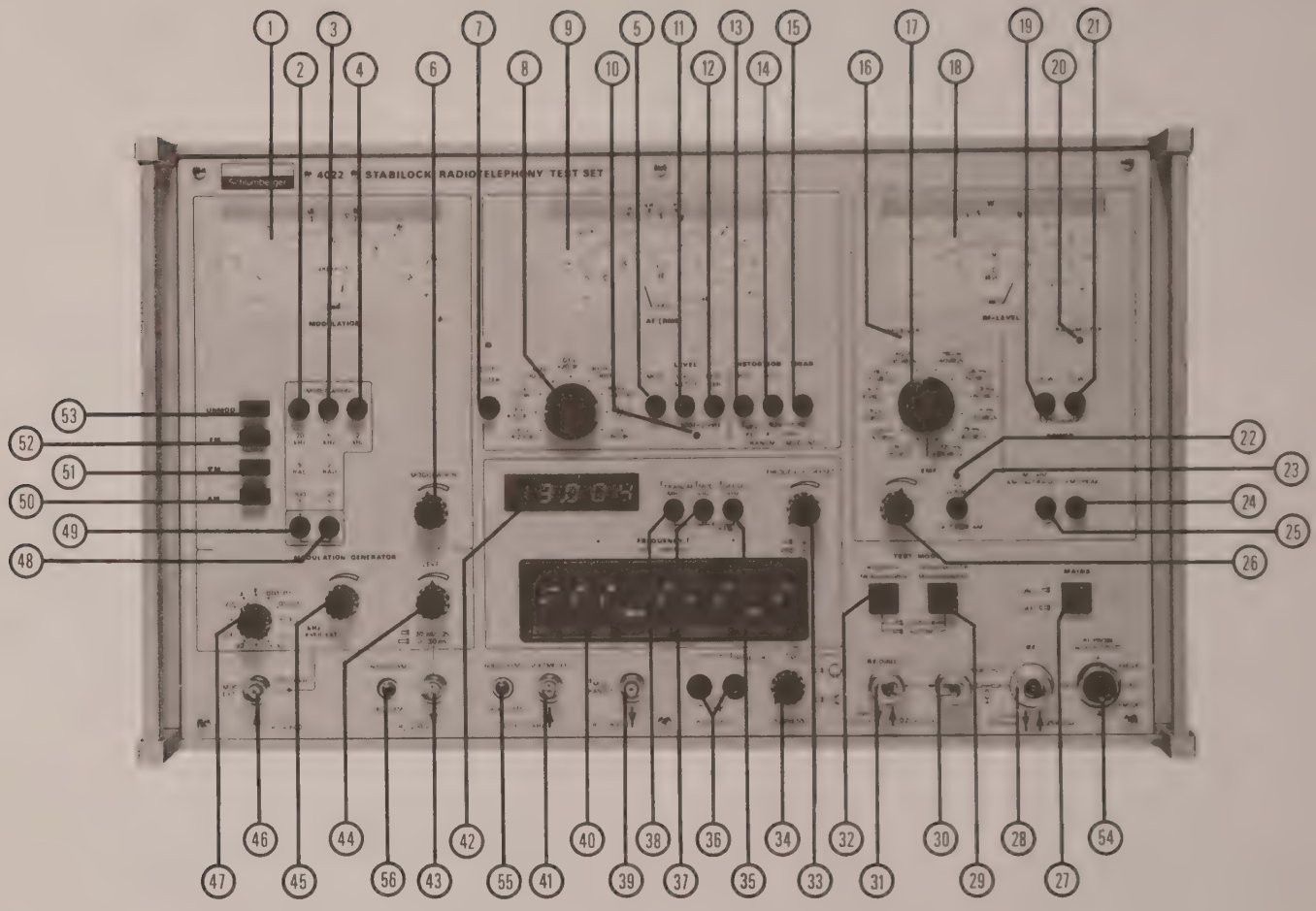
Thes alignment is very critical.
Please pay attention to the manufacturers specifications and instructions.

COMMENT

Because both transmitter and receiver of a Duplex radiotelephony system operate with a common aerial, the receiver would be inoperable unless a filter were employed to separate the receiver and transmitter channels. Such a separating filter should present a low transmission loss for the receiver channel but a high attenuation for the transmitter channel. The required stop-band attenuation, depends on the type of system, but normally between 30 and 60dB.

NOTE: In mobile radiotelephony systems the transmitter usually operates in the lower-band and the receiver in the upper-band; in stationary systems the opposite is, however, normally true.





1. Modulation indication
2.]
3.]-Modulation measurement ranges
4.]
5. Spurious modulation measurement by AF voltmeter
6. Control for setting modulation on RECEIVER MEASUREMENT
7. CCITT weighting filter ON/OFF
8. Switch for selecting ranges of AF millivoltmeter
9. Indication of AF millivoltmeter and distortionmeter
10. Indication for 20 dB decreased sensitivity of AF millivoltmeter
11. Millivoltmeter measures level of AF input
12. Millivoltmeter measures output voltage of AF generator (43)
13. Selecting of distortionmeter range 30%
14. Selecting of distortionmeter range 10%
15. Selecting of distortionmeter range SINAD Applied to distortionmeter; AF input (43) in RECEIVER MEASUREMENT mode, demodulated signal in the TRANSMITTER MEASUREMENT mode
16. Light for indication of RECEIVER MEASUREMENT mode
17. Step attenuator for EMF setting
18. Indication of EMF or power from transmitter
19. Power measuring range 2.5 W f.s.d
20. Light for indication of TRANSMITTER MEASUREMENT mode
21. Power measuring range 25 W f.s.d
22. Light for indication of +6 dB increased EMF
23. Push button for increasing EMF +6 dB
24. Peak power measurement mode
25. Average power measurement mode
26. Vernier setting of EMF
27. Mains switch
28. RF input and RF output, protected by high power attenuator
29. Push button for selecting TRANSMITTER MEASUREMENT mode
30. Socket for connecting cable link
31. Unproducted output RF DIRECT, input for telemetering
32. Push button for selecting RECEIVER MEASUREMENT mode
33. Control and switch for setting vernier offset and selecting polarity
34. Control for setting loudness level and switch loudspeaker/headphones. Depending on positions of (37) and (35) loudspeaker provides demodulated signal or offset (beat) frequency.
35. Counter measures offset frequency
36. Banana jack for headphones
37. Counter measures modulation frequency in RECEIVER MEASUREMENT mode and frequency of demodulated signal in TRANSMITTER MEASUREMENT mode
38. Counter measures frequency of transmitter
39. Output provides demodulated signal
40. Switch for setting channel frequency
41. Symmetrical AF voltmeter input (Mating plug: 886 286)
42. Counter display
43. Symmetrical modulation generator output (Mating plug: 886 286)
44. Control for output level of modulation generator
45. Vernier adjustment of modulation frequency
46. Input for external modulation
47. Setting of ranges for modulation generator
48. Selecting of +/-/± modulation
49. Peak value indication
50. Setting of modulation mode AM
51. Setting of modulation mode FM
52. Setting of modulation mode φM
53. Setting of modulation mode UNMOD
54. Socket RF PROBE/AUX OUTPUTS (Mating plug: 884 271)
55. Selects AF voltmeter impedance
56. Selects source impedance of the modulation generator

Both buttons RECEIVER and TRANSMITTER MEASUREMENT released: Selection of the TRANSMITTER MEASUREMENT mode automatically when the transmitter power exceeds 50 mW.

ENERTEC
Schlumberger

For repair orders please fill in this form and dispatch it with the instrument.
Comprehensive fault descriptions will save repair expenses.

FAULT MESSAGE	Costumer ..... Phone no.	Reported by .....
STABILOCK type ..... Serial number	.....	Date .....

(1) Fault location

Frequency		Modulation	FM	AM	φM	Power measurement		Output level		Attenuator	dB
Offset measurement		Modulation generator				AF Voltmeter		Dist. measurement			

(2) Operating frequency ☐☐☐,☐☐☐ MHz Fault also at other frequencies? yes ☐ no ☐

(3) Mode of operation

Transmitter measurement		local	
Receiver measurement		remote	

(4) Fault appears

continuously		after switch on		when the instrument is cold	
at times		after longer switching-on time		at normal operating temperature	

(5) Defective switches Switch no.: Number corresponding to sheet "Operating Controls" of the operating manual

(6) Defective meters Modulation meter ☐ AF meter ☐ Power meter ☐

(7) Defective counter RF frequency ☐ Mod. frequency ☐ Offset frequency ☐

(8) Further instructions .....
.....

(9) Substitute STABILOCK during repair at a lending fee yes ☐ no ☐

MP MASTER
MA23586